SAE JOURNAL

APRIL
1953

IN THIS ISSUE . . .

- PASSENGER CAR design trends in:
  a. Post-War European cars . . . page 17
  b. 1953 American models . . . page 49
- RADOMES of glass-reinforced plastic pass beam, shield radar . . . page 27
- GATE-HOUSE-ON-WHEELS for airline passengers may spark revolution in airport design . . . page 36
- ALUMINUM SKIN grafted to steel bodies new way . . . page 40

PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS

Chrome Plated STEEL Compression Rings —Pioneered by PC—Offer Greatly Increased Resistance to Breakage

Behind this statement lies the story of a decade of research, testing and development ...of trial and error, and finally of trial and success.

During World War II Perfect Circle engineers, working with the Air Corps, first developed practical production processes for making chrome-plated STEEL compression rings. The ultimate high output aircraft engine achievements might not have been realized without experience gained in PC's experimental production unit.

Today, refined and improved PC Chrome Plated STEEL Compression Rings are indispensable in many heavy-duty installations. Features of these special purpose rings are: greatest possible resistance to breakage; higher unit pressure and conformability than with cast materials; good heat stability.

Perfect Circle

PISTON RINGS

THE STANDARD OF COMPARISON

Perfect Circle Corporation, Hagerstown, Indiana; The Perfect Circle Co., Ltd., Toronto, Ontario

● The "third degree" is but a superficial scanning compared to the trials a ball bearing must withstand in New Departure's Research Laboratory. Here, under conditions which pack years of normal use into a short time, engineers determine how to make the best ball bearings even better.

Production bearings and experimental designs, alike, take this "torture treatment." They are subjected to overspeeds and overloads, intense heat and cold, day and night operation for protracted periods.

Search and Research

Three decades of this search and research have produced the sealed rear wheel-bearing for motor cars, the self-sealed bearing for farm implement use, the tiny, jewel-like bearing for delicate instruments . . . and many other types to fit a host of applications.

You can specify New Departures and *know* that they are right for the job. Keep your eye on the BALL to be sure of your BEARINGS!

Vibration analyzer eliminates human error in scientific search for causes of noise in bearings.

New Departure ball bearings are readily available at your equipment dealer or bearing distributor —supplied from the industry's largest network of warehouse stocks.

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Also Makers of the Famous New Departure Coaster Brake

Specify

N-A-X
HIGH-TENSILE STEEL

BUMPER FACE-BAR

for

High Strength and Impact Resistance with Excellent Cold-Formability

N-A-X HIGH-TENSILE, having 50% greater strength than mild carbon steel, permits the use of thinner sections—resulting in lighter weight of products. It is a low-alloy steel—possessing much greater resistance to corrosion than mild carbon steel, with either painted or unpainted surfaces. Combined with this characteristic, it has high fatigue and toughness values at normal and sub-zero temperatures and the abrasion resistance of a medium high carbon steel—resulting in longer life of products.

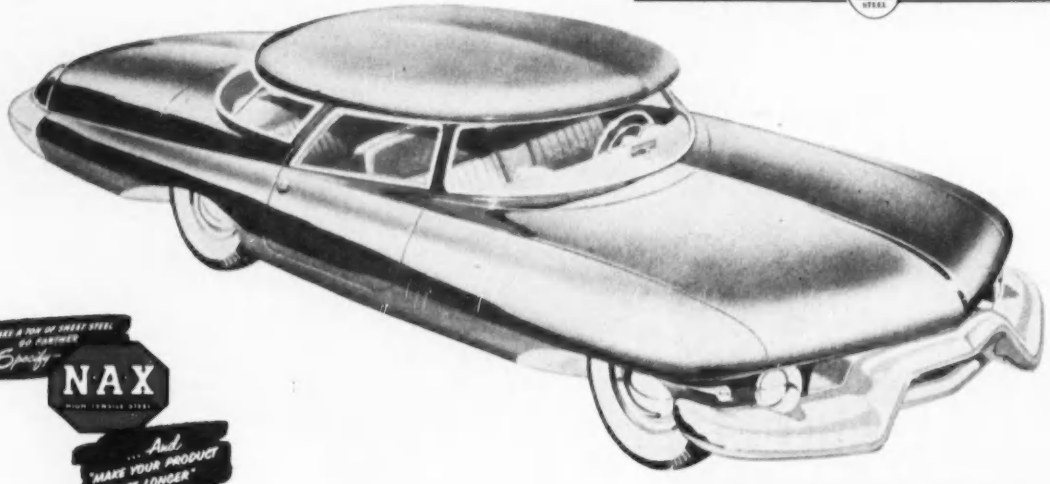
N-A-X HIGH-TENSILE, with its higher physical properties, can be readily formed into the most difficult stamped shapes, and its response to welding, by any method, is excellent. Due to its inherently fine grain and higher hardness, it can be ground and polished to a high degree of lustre at lower cost than can mild carbon steel.

Your product can be made lighter in weight . . . to last longer . . . and in some cases be manufactured more economically, when made of N-A-X HIGH-TENSILE steel.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division — Ecorse, Detroit 29, Mich.

NATIONAL STEEL CORPORATION



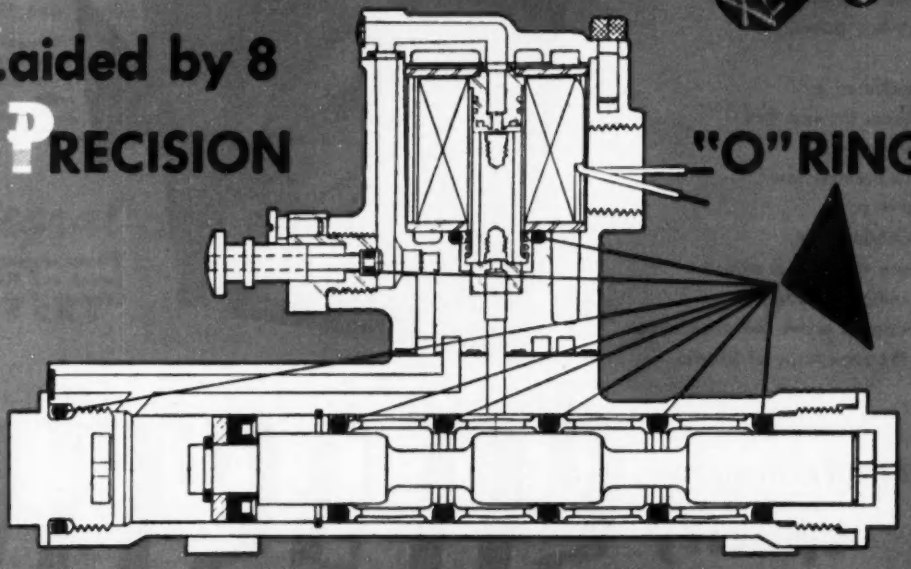
MAKE A TON OF SHEET STEEL GO FARTHER
Specify N-A-X
... And "MAKE YOUR PRODUCT LAST LONGER"

KEEP YOUR SCRAP MOVING TO YOUR DEALER

SAE JOURNAL, April, 1953, Vol. 61, No. 4. Published monthly by the Society of Automotive Engineers, Inc. Publication office at 10 McGovern Ave., Lancaster, Pa. Editorial and advertising department at the headquarters of the Society, 29 West 39th Street, New York 18, N. Y. $1 per number; $10 per year; foreign $12 per year; to members 50 cents per number, $5 per year. Entered as second class matter, September 15, 1948, at the Post Office at Lancaster, Pa., under the act of August 24, 1912. Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph (d-2), Sec. 34.40, P. L. and R., of 1948. Additional entry at New York, N. Y.

55 million cycles and this 4-way valve is still going strong!

..aided by 8 PRECISION "O" RINGS



This pilot-operated 4-way valve—developed by THE VALVAIR CORPORATION of Akron, Ohio—employs 8 *Precision* "O" Rings for leak-proof sealing under air, oil, water or inert gas pressure. Designed to give trouble-free performance for more than 50 million cycles of heavy-duty service, this compact valve requires "O" Rings of *highest quality*—and that is why *Precision* "O" Rings were chosen!

Everyone is finding *Precision* "O" Rings the best answer to many sealing problems—and they are finding, too, that *Precision* leads the field in engineering help and proper deliveries to keep production lines going. Let us work with you. Send for our "O" Ring Handbook and let us have your inquiries.

FREE—Write for your personal copy of our new Handbook on "O" Rings.

Precision Rubber Products CORPORATION

"O" Ring and Dyna-seal Specialists

3110 Oakridge Drive, Dayton 7, Ohio Canadian Plant at: Ste. Thérèse de Blainville, Québec

As a flexible seal for limit switches exposed to weathering and temperatures below —100°F, *Silastic works where other materials fail.**

Reliability is imperative in hermetically sealed limit switches used to control such aircraft parts as landing gear, bomb bay doors, turrets and flaps. Evaluation tests conducted by Electro-Snap engineers showed that Silastic was the only material flexible enough at extremely low temperatures to serve as a diaphragm-type wobbling seal. Faultless performance for over a million test cycles plus qualification under government specifications prove the excellence of the design and the superiority of Silastic.

fig. 1 *Actuating arm of switch held in depressed position and exposed to —100°F for several hours.*

fig. 2 *Actuating arm of switch released from depressed position responds instantly, demonstrating the flexibility of the Silastic seal.*

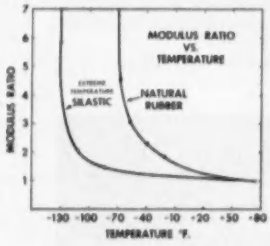
Photos courtesy Electro-Snap Switch and Manufacturing Company, Chicago, Illinois.

for superior performance specify

SILASTIC

the Dow Corning silicone rubber

Silastic stocks designed for extreme temperature applications are the only materials that will retain rubbery properties after continuous long term exposure to temperatures from —80 to 300-350°F or after repeated short term exposure to temperatures from —130° to 500°F.



As a standard for low temperature performance, we call your attention to our data[1] on modulus ratios, or relative stiffening, as measured by the Gehman test method. According to these data (see Figure) the modulus for Extreme Temperature Silastic shows no appreciable change above temperatures in the range of —112 to —130°F. Rapid change in the modulus for natural rubber and for most silicone rubber stocks takes place between —40 and —70°F.

All types of Silastic show excellent resistance to oxidation, weathering and to a variety of hot oils and chemicals. Silastic stocks for electrical applications are unique even among silicone rubbers for low water absorption and excellent dielectric properties combined with good physical strength.

Data and actual performance prove that you can count on Silastic to retain both its physical and dielectric properties after long exposure to outdoor weathering or to temperatures far above and below the limits of natural or synthetic organic rubbers.

[1] *Polmanteer et al, Ind. and Eng. Chem. Vol. 44, Page 1576, July 1952.*
**T.M. Reg. U. S. Pat. Off.*

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Please send me:
- ☐ Silastic Facts 10a, properties and applications of Silastic stocks and pastes.
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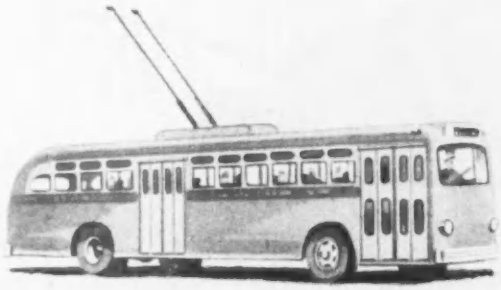
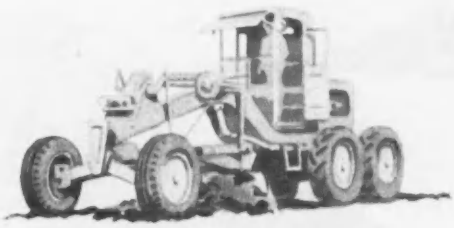


BUSES AND TROLLEY COACHES



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TRUCKS

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Integral and *Linkage* types

FOR EVERY POWER STEERING NEED

PASSENGER CARS

Trucks, buses, tractors, passenger cars, heavy-duty work vehicles of many types—*all* set new performance standards with ROSS HYDRAPOWER Hydraulic Power Steering.

New steering and parking *ease* . . . shock-free driving *comfort* . . . *faster* work schedules . . . greater *safety* for driver and passengers . . . increased *protection* for vehicle and payload—just experience for yourself these many advantages and you'll agree—ROSS HYDRAPOWER doesn't *cost*, it *pays*.

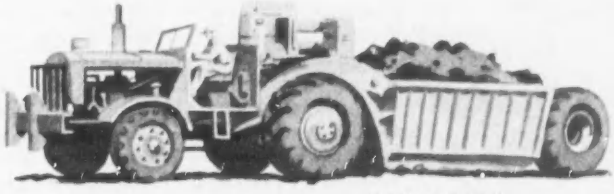
And effortless, fatigueless ROSS HYDRAPOWER fully retains the "normal road feel" and "sense of full control" so characteristic of *all* Ross Cam & Lever Steering. Road obstructions . . . rutted, bumpy terrain . . . tire blow-outs—*any* sudden shock that might threaten control is safely, automatically "absorbed" by ROSS HYDRAPOWER.

Exclusive steering specialists for nearly a half century, Ross supplies both "integral" and "linkage" types ROSS HYDRAPOWER for every power steering need. We invite discussion of *any* steering problem.

TRACTORS

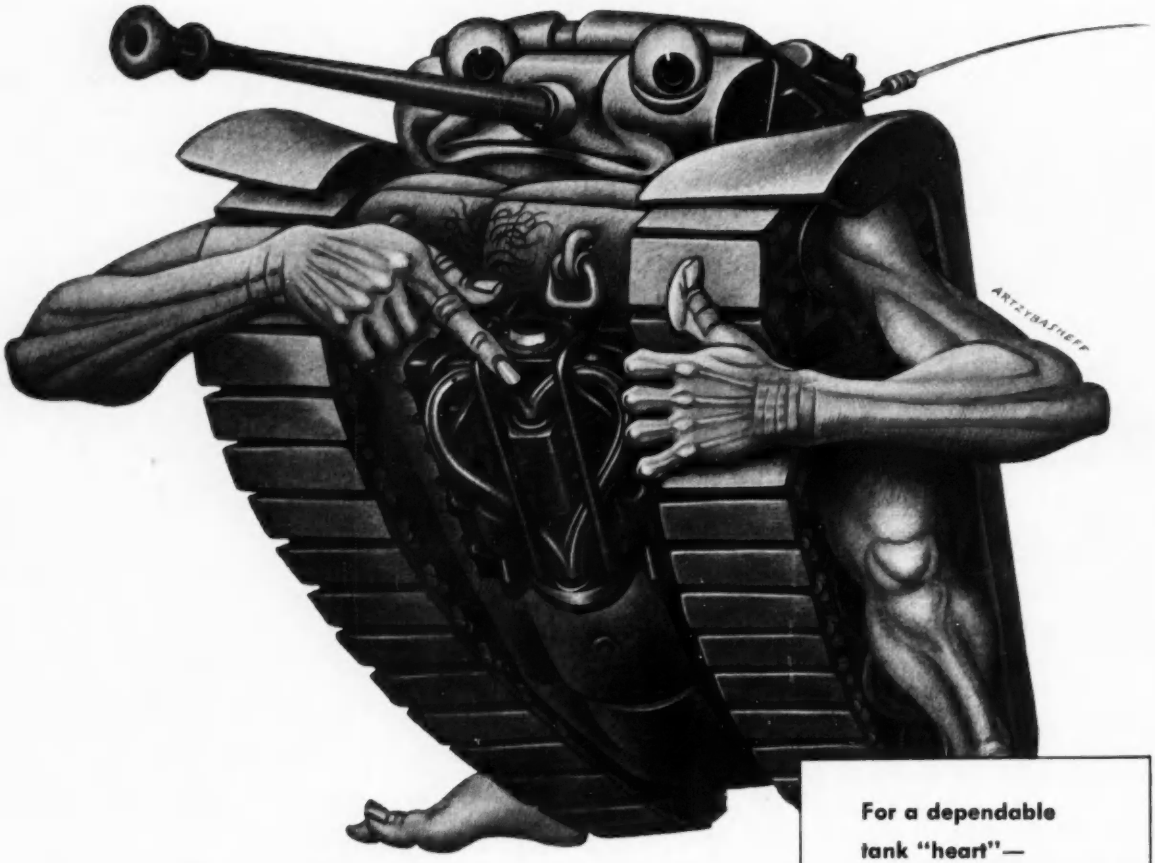
HYDRAPOWER Ross

Cam & Lever STEERING



EARTH MOVERS

ROSS GEAR AND TOOL COMPANY • LAFAYETTE, INDIANA



New "ticker" for tanks

Rumbling over rugged terrain . . . crushing enemy obstacles . . . surviving heavy fire—our "G.I." tanks must have powerful, dependable engines to stay "alive" in combat. That's why the Army Ordnance Corps relies on Lycoming to turn out air-cooled "tickers" for new-type tanks now in production.

Maybe you need a complete engine, or a single precision part. Maybe you have "only an idea" in the rough or blueprint stage that needs development. Or a metal product that needs precise and speedy fabrication. In *any* case—look to Lycoming! Lycoming has a long-tested reputation for meeting the most exacting and diverse metal-working requirements, both industrial and military. *Whatever* your problem—look to Lycoming!

Lycoming's wealth of creative engineering ability, its 2½ million square feet of floor space, its 6,000-plus machine tools stand ready to serve your needs.

For a dependable tank "heart"—500 horsepower's worth of rugged air-cooled engine—U. S. Army Ordnance looks to Lycoming's precision production.

AIR-COOLED ENGINES FOR AIRCRAFT AND INDUSTRIAL USES • PRECISION-AND-VOLUME MACHINE PARTS • GRAY-IRON CASTINGS • STEEL-PLATE FABRICATION

FOR RESEARCH · FOR PRECISION PRODUCTION

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Please send me further information on Lycoming's varied abilities and facilities.

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NOW! South Wind HEATING SYSTEMS

combine these 3 benefits in one heater!

1 engine pre-heating

Answers needs of all types of engines, all pre-heating requirements. Heats engine components, battery, crankcase, carburetor with warm, dry air. Makes starting easier, faster—*even at 65° below!*

2 personnel heating

Warm air—independent of engine heat, independent of engine operation—circulates swiftly, evenly, to keep personnel comfortable at all times.

3 windshield defrosting

Keeps windshield reliably "frost-free." Assures clear vision, safer driving.

Model 1030
—30,000 BTU/hr. output.

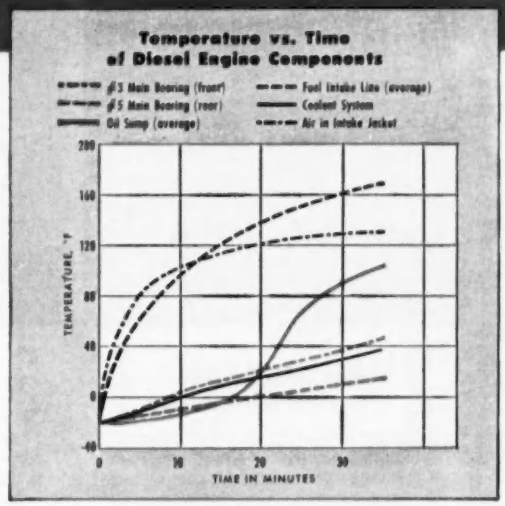
FIGURES THAT PROVE SOUTH WIND'S SUPERIORITY

Lab Tested . . . Field Tested . . . Best by Every Test!

South Wind's entirely new principle of scientific pre-heating has been developed, tested and proved in the field, as well as in the Stewart-Warner Laboratory Cold Room.

Here is a typical temperature record of critical engine components during pre-heating (only minimum capacity 70,000 BTU/hr. pre-heater kit used). This heat provided adequate temperature rise for easy starting—with less than 5-seconds cranking.

Data is based on a 6-cylinder, 2-cycle, 225 HP Diesel engine, weighing 3,000 pounds.



Compact, powerful, dependable Stewart-Warner "South Wind" pre-heating systems are first choice of engineers and maintenance men for these reasons:

1. Provides quick starting required by Military Services—even at 65° below.
2. One heater provides engine starting, cab heating and defrosting.
3. Provides only clean, *dry* hot air to engine.
4. Permits use of optimum viscosity lubricants.
5. Normal lubrication at all times.
6. Lowers engine maintenance cost—prolongs engine life.
7. Reduces battery drain by reducing starting torque.
8. Eliminates cost of expensive starting aids.
9. Eliminates shock loads imposed by brute force starting methods.
10. Inhibits sludge formation and freeze-up of engine accessories.

There's a South Wind Heater for Every Pre-Heating Need

Do You Have A Heating Problem? Write today for the experienced counsel of South Wind field engineers about *any* problem in external or internal pre-heating. The wide range of South Wind Heaters includes 20,000—30,000—50,000—100,000—200,000 and 600,000 BTU/hr. capacities. Write South Wind Division, Stewart-Warner Corporation, Indianapolis 7, Indiana.

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South Wind

PERSONNEL HEATING
ENGINE AND
EQUIPMENT PRE-HEATING
WINDSHIELD DEFROSTING

seven ways you save

WITH REYNOLDS FABRICATING FACILITIES

These photographs are representative of the tremendous Reynolds fabricating facilities . . . facilities that make possible seven basic economies to every manufacturer who uses Reynolds Aluminum Fabricating Service.

Not shown in these photographs, are two equally important advantages that Reynolds offers manufacturers. One, quality and production control from mine to finished product. Two, experienced design and engineering service.

You'll see *proof* of the latter advantages—along with proof of the seven basic economies pointed out in the photo captions—in each aluminum blank, roll formed shape, completed part or final assembly you get from Reynolds.

For your present needs or for development work on future models, contact your nearest Reynolds office listed under "Aluminum" in your classified telephone directory or write for your copy of the new "Complete Facilities" catalog to Reynolds Metals Company, Parts Division, 2086 South Ninth St., Louisville 1, Ky.

2 Reynolds REDUCES YOUR RAW MATERIAL INVENTORY

You get *pounds of parts* instead of pounds of metal when you use Reynolds Aluminum Fabricating Service. Like the automobile manufacturer who will receive the extruded aluminum window frames above, you can save, too, by cutting out that costly part of your metal inventory that does not go into finished parts. Over 30 Reynolds plants in 18 states are at your service!

3 Reynolds RELEASES YOUR VALUABLE FLOOR SPACE

Pictured above are just a few of 6,000 *different parts* for a single plane in production at Reynolds plants at one time during World War II. Imagine the floor space required for this production. Imagine the floor space *you* can save in *your plant*—space you can put to profitable use—when you call on Reynolds Aluminum Fabricating Service to turn out aluminum parts for your products.

4 Reynolds ADDS TO YOUR CAPACITY WITHOUT INCREASING COSTS

Here, in the photograph above, aluminum TV antenna is being formed on one of the seventeen Reynolds roll forming machines. The great variety of Reynolds specialized equipment enables you to obtain the economy of the machines best suited to your purpose, without making the tremendous capital investment in equipment and added plant capacity which would otherwise be required.

Be sure to see "Mister Peepers" every Sunday night, 7:30 EST, NBC-TV

REYNOLDS ALUMINUM

BLANKING • EMBOSSING • STAMPING • DRAWING • RIVETING •

1 Reynolds CUTS YOUR SCRAP LOSS AND SCRAP HANDLING COSTS

The aluminum blanks on the conveyor at left are ready to go to a washing machine manufacturer. The scrap beside the press is remelted immediately right at the Reynolds plant. Thus Reynolds Aluminum Fabricating Service saves you—the manufacturer—an average of 30% scrap loss and also eliminates scrap handling expense on your part in sorting, storing and shipping.

5 Reynolds CUTS YOUR MATERIAL HANDLING COSTS

The aluminum pallets above will reduce material handling costs in many plants . . . and the manufacturer of these pallets is also reducing *his* material handling costs by getting *pounds of parts*, not pounds of metal, from Reynolds Aluminum Fabricating Service. Reynolds also takes the problems of scheduling, material supply, labor and machine availability off his—and your—hands!

6 Reynolds OFFERS YOU DELAYED MATERIAL BILLING

You receive 100% of your aluminum in finished parts when you use Reynolds Aluminum Fabricating Service. And, as these parts are generally billed after assembly into finished products, no investment is tied up in raw metal. These quality parts, like the shells of the aluminum cookers being buffed above, are available in a wide choice of finishes including color-anodized.

7 Reynolds ELIMINATES YOUR REJECT COSTS

Reynolds Aluminum Fabricating Service does away with your machine and labor production losses and inspection expense in rejects, because you pay only for finished, inspected parts. The conveyor line above, where refrigerator door trays are carefully inspected before packing and shipping, is just one of the many examples of Reynolds quality control from mine to finished product.

hear "Fibber McGee and Molly" every Tuesday night, 9:30 EST & PST, NBC radio

FABRICATING SERVICE

ROLL SHAPING • TUBE BENDING • WELDING • FINISHING

A Dynamometer Control Panel for testing Brake Lining at American Brakeblok.

Our Dynamometer Room is a busy place, testing and compiling preliminary brake lining performance data.

By duplicating "road" conditions, answers are obtained on deceleration, stability, life, fade, recovery, moisture, sensitivity and other fundamentals.

This knowledge is important to you because it cuts down your costly and time-consuming tests. It provides you with accurate information for your evaluation. In addition, it gives us a backlog of information to help you solve your brake lining problems.

American Brakeblok

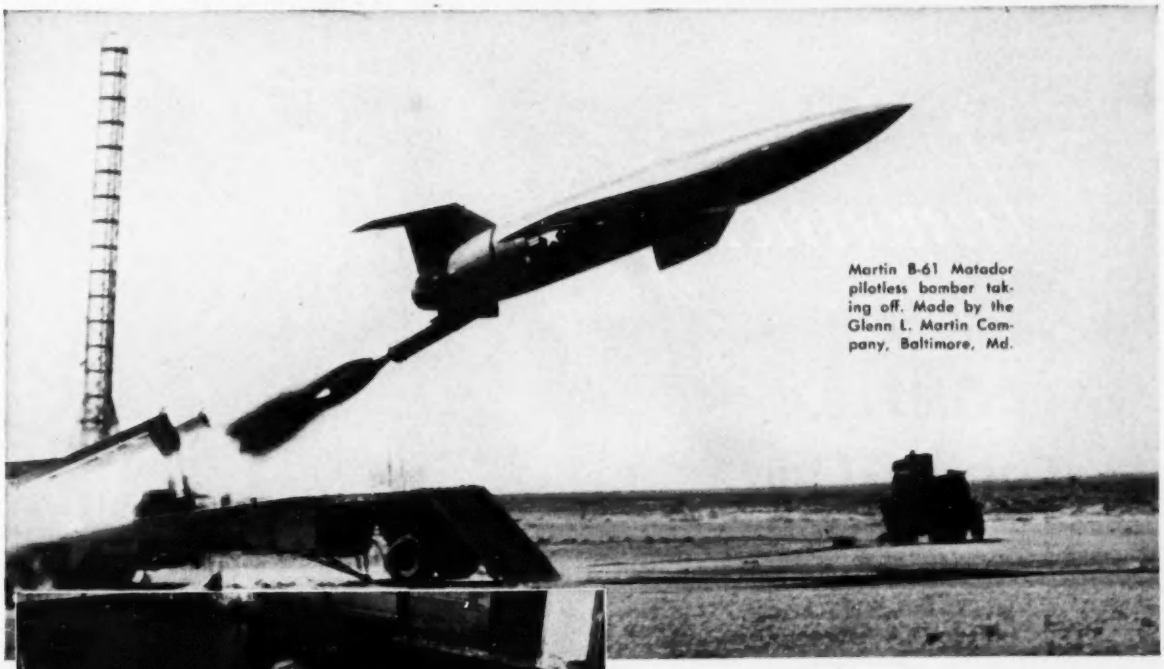
THE SAFETY BRAKE LINING

AMERICAN Brake Shoe COMPANY

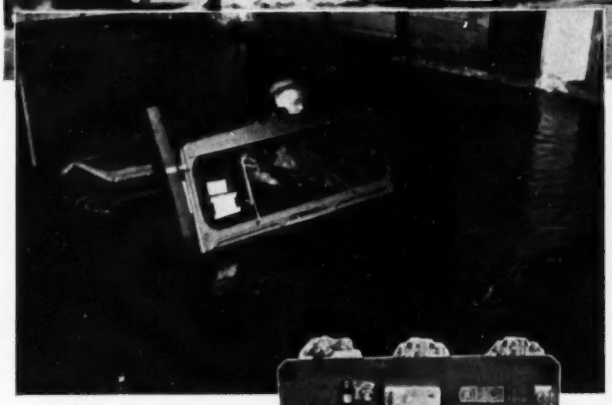
Copyright 1953, American Brake Shoe Company

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN

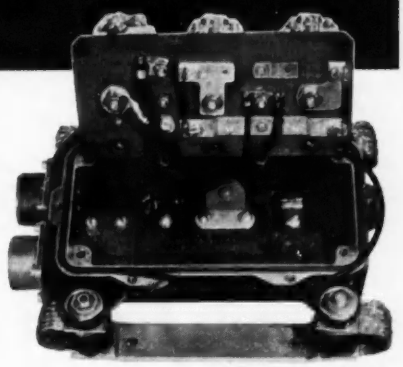
Plants in:
Detroit, Michigan; Winchester, Virginia; Hillburn, New York; Lindsay, Ontario; Gif, France



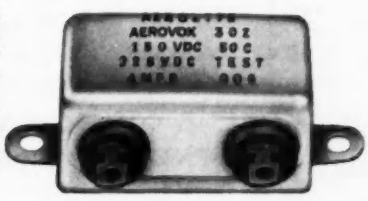
Martin B-61 Matador pilotless bomber taking off. Made by the Glenn L. Martin Company, Baltimore, Md.



Jeep almost completely submerged. Can be operated in this position at about 9 miles per hour. Made by Willys-Overland Motors, Inc., Toledo, Ohio, for the Armed Forces.



Generator regulator for the 24-volt system of the submersible Jeep. This is completely waterproof and highly resistant to corrosion and fungi. Produced by The Electric Auto-Lite Company, Toledo, Ohio.



Illustrated are two of the many types of capacitors and filters made by Aerovox Corporation, New Bedford, Mass.; an important capacitor supplier to both Electric Auto-Lite and Glenn L. Martin. The unit above is the filter capacitor used in the generator regulator of the submersible jeep while the unit at the right is used in the pilotless bomber.

In the Air— On Land— Under Water—

WHERE REQUIREMENTS ARE SEVERE, CALL REVERE

The dramatic pictures on this page show two important special applications of Aerovox capacitors. One is the Martin B-61 Matador pilotless bomber. It contains an Aerovox capacitor, which has to withstand the terrific acceleration and speed of the craft. The other is the submersible Jeep. Its 24-volt electrical system is completely waterproofed, and includes Aerovox filters and capacitors for suppression of radio interference. Revere not only supplied copper and brass strip for the capacitor cases, but collaborated closely in setting up specifications, and in addition worked on a welding problem. In regard to the latter, an Aerovox Project Engineer wrote: "We have had much better welds." . . . Revere is always glad to collaborate on problems concerning copper and its alloys, aluminum alloys, and electric welded steel tube. Call the nearest Revere Sales Office.

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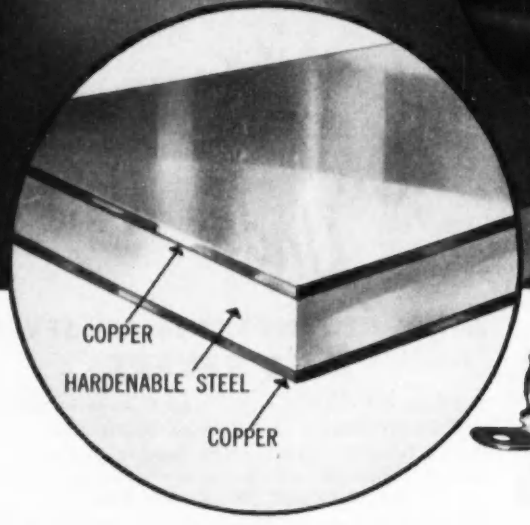
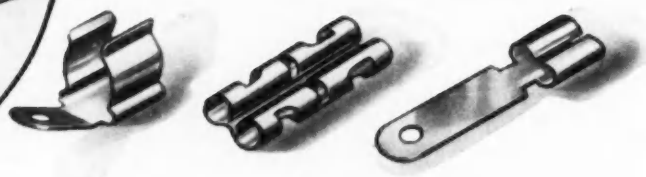
Announcing

General Plate CONFLEX Copper-Clad HARDENABLE Steel





For High Conductive Electrical Spring Parts at Low Cost

Here's a new General Plate Composite Metal — *CONFLEX copper clad on hardenable medium carbon steel* — that can solve many of your electrical spring problems.

Comparable to beryllium copper in many respects, its primary advantage is *lower cost.* In addition, *CONFLEX copper-clad hardenable steel* has greater stiffness than hardenable copper alloys.

General Plate single or double copper-clad hardenable steel offers high electrical and thermal conductivity. Thickness ratios can be produced to give higher electrical conductivity than hardenable copper alloys when the same overall thickness of materials are compared.

CONFLEX copper-clad hardenable steel can be used advantageously for such applications as fuse clips, flat springs and electrical connectors. In other applications, such as pen and pencil clips, the layer of copper provides an excellent surface for an electro-plated finish.

General Plate products include . . . precious metals clad to base metals, base metals clad to base metals, silver solders, composite contacts, buttons and rivets, Truflex® thermostat metals, Alcuplate®, platinum fabrication and refining, #720 manganese age-hardenable alloy. Write for complete information and Catalog PR700 today.

You can profit by using General Plate Composite Metals!

METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
114 FOREST STREET, ATTLEBORO, MASSACHUSETTS

For the Sake of Argument

Leadership—Up as well as Down . . .

By Norman G. Shidle

"I heartily endorse the philosophy expressed in your January, 1953 editorial. I believe I have used it successfully for a good many years. In fact, to me it seems far easier to lead my own staff than to push it . . . but what does one do with one's own supervision?" So writes a near-the-top executive reader of our January FSOA which quoted one executive who had concluded: "It's important that my staff buy me. It's not sufficient that they just take me."

Then our reader continues: "Theoretically the system should work as well upward as downward, but for some reason it seems more difficult for me to apply in the upward direction. I wonder if I'm peculiar or if this is a general weakness—and if so, why?"

We'd like to hear from other readers on this one. We think it *is* harder to lead your superiors than your subordinates; harder to make the system work upward than downward.

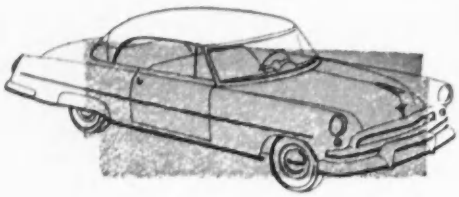
But there's this difference: The "leadership" theory is the only one that can possibly be successful on the "upward" side. There isn't much choice. A subordinate is rarely successful in issuing orders to superiors. In dealing with organization superiors, we usually get results by leadership or don't get them.

Many years ago, a wise counselor advised a young executive thus:

"The best way to 'lead' a boss is to think always of management's problems as your department's problems. Then keep your supervisor full of plans and projects for your department which will help contribute to specific, current management aims.

"The manager who is interested in and sold on projects you have proposed is less likely to be issuing orders to do things he has dreamed up. He's going to spend just about so much time thinking about your operation. Whether he spends it considering good ideas you have proposed or in thinking up things *he* thinks you should be doing rests largely with you."

Trial-and-error tests of this theory over the years, have led that no-longer-young man to conclude: "There's quite a lot in it."



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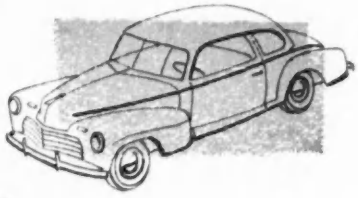

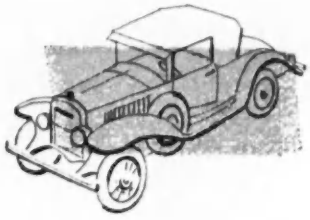

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Contents—April 1953

Post-War European Cars—MAURICE OLLEY 17

Plastic Radomes Pass the Beam But Shield the Radar—W. GARCIA, C. A. GIBBONS, H. A. HUMMEL and A. S. LEIPZIG, F. E. LENHERR, E. T. PHILIPS, J. A. SPORCIC and R. L. WHANN 27

Synthetic Lubricants for Winter Operation—J. A. MILLER and H. F. GALINDO 32

Mobile Gate House Could Revolutionize Airport Design—E. W. FULLER .. 36

Here's How to Graft Aluminum Skin to Steel—D. K. HANINK and A. L. BOEGEHOLD 40

Flight Tests Are Vital to Jet Installation Development—J. R. STEDING .. 47

Engineering Highlights of 1953 Passenger Cars—W. S. JAMES 49

■

Technical Committee Progress 75

Report of 1953 SAE National Passenger Car, Body and Materials Meeting 80

About SAE Members 88

News of SAE 95

National Meetings 99

Program for 1953 SAE National Aeronautic Meeting, Aeronautic Production Forum, and Engineering Display 100

SAE Section Meetings 104

SAE Section News 105

SAE Student News 106

Students Enter Industry 131

Technical Digests 136

New Members Qualified 142

Applications Received 147

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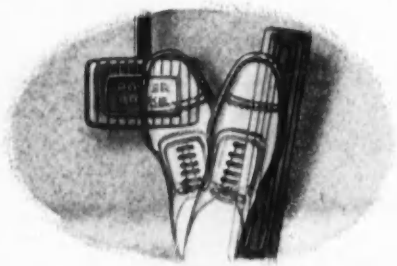

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How Post-War European Cars . . .

• Differ from U.S. Cars

• Stack Up Against Each Other

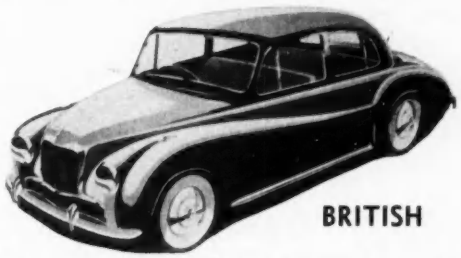
• Are Put Together

• Fit Special Cases But Can't Swap Places

Maurice Olley, Chevrolet Motor Division, General Motors Corp.

Based on paper "European Post-War Cars" presented at SAE Annual Meeting, Detroit, Jan. 14, 1953, and at SAE Detroit Section on Oct. 1, 1952. This paper will be published in full in 1953 SAE Transactions. Complete copies of the paper in multilithographed form may be obtained from SAE Special Publications Department at 25¢ a copy to members, 50¢ to nonmembers.

How They Differ from U.S. Cars . . .



BRITISH

GERMAN

POST-WAR EUROPEAN CARS generally cost less, use less precious motor fuel, and are smaller, lighter, and narrower than American ones. They are also more nimble on the road, have better road-holding ability, and allow a more intimate view of the road around the vehicle. On the other hand, they are generally low in performance in the hands of the average driver, less completely appointed, much noiser, and less comfortable. In appearance, however, nearly all post-war European cars are related to American styling. British and Germans have accepted

FRENCH

ITALIAN

it perhaps unwillingly, the French with reservations, the Italians enthusiastically. In the four typical styles shown, wheels are set almost flush with the sides of the vehicle. Overhangs, both front and rear, are less than in American cars. Wheelbases are frequently longer, relative to overall length of the car, especially in those designs which make the strongest bid for maximum road-holding ability. Interior width is based on two passengers, not three. Baggage space is more or less restricted. Bumpers are less massive and ornate. In short, the European design problem is to combine a large interior with a small exterior.

How They Stack Up Against Each Other . . .

General Specifications

	SIX SMALL CARS	EIGHT SMALL-MEDIUM CARS	SEVEN MEDIUM CARS
Wheelbase, Inches	84.1	96.3	103.3
Tread, Inches	47.4	50.7	53.15
Overall Length, Inches	142.4	162.0	171.8
Overall Width, Inches	56.0	63.4	66.35
Number of Cylinders	2 or 4	4	4 or 6
Displacement, Cubic Inches	41.0	82.0	132.3
Forward Speeds	4	3 or 4	3 or 4
Axle Ratio	4.670	4.845	4.206
Curb Weight, Pounds	1418	2264	2604
List Price, Sedan	$900-$1200	$1255	$1543

Body-Frame Construction

	32 BRITISH	17 GERMAN	13 FRENCH	7 ITALIAN
Frame	19	5	5	2
Full Frameless Construction	12	4	7	4
Platform Construction	1	4	1	1
Tubular Backbone	—	4	—	—

Engine and Drive Location

	32 BRITISH	17 GERMAN	14 FRENCH	7 ITALIAN
Conventional Front Engine, Rear Drive	32	9	7	7
Front Engine, Front Drive	—	5	6	—
Rear Engine, Rear Drive	—	3	1	—

Rear Suspension

	32 BRITISH	17 GERMAN	14 FRENCH	7 ITALIAN
Rigid Axle and Leaf Spring	28	4	5	4
Rigid Axle and Torsion Rod	2	1	4	—
Rigid Axle and Coil Spring	—	—	2	2
Torque Tube	2	1	—	—
Swing Axle	—	10	1	—
Semi-Swing Independent	—	—	1	1
Parallel Radius Arm	—	1	1	—

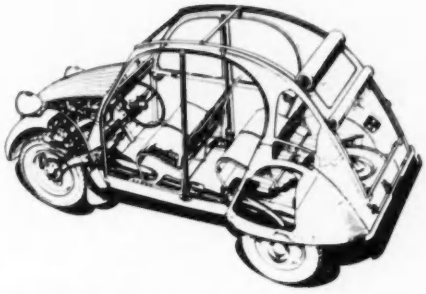
Front Suspension

	32 BRITISH	17 GERMAN	13 FRENCH	7 ITALIAN
Coil Spring Wishbone	19	7	7	3
Transverse Leaf Spring	3	6	3	2
Torsion Rod Wishbone	8	—	2	—
Torsion Rod Parallel Link	—	2	—	—
Telescope Spring	2	—	—	2
Rubber	—	2	—	—
Radius Arm Coil Spring	—	—	1	—

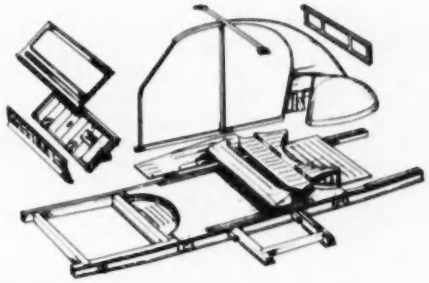
Engines

4-Cycle Engines	32 BRITISH	19 GERMAN	12 FRENCH	7 ITALIAN
4-Cyl. Vert. Water Cooled Displacement, Cubic Inches	20 99.6	5 94	6 95.2	5 78.7
6-Cyl. Vert. Water Cooled Displacement, Cubic Inches	11 153.9	4 147	2 158	—
4-Cyl. Horiz. Water Cooled Displacement, Cubic Inches	1 90.7	—	—	—
4-Cyl. Horiz. Air Cooled Displacement, Cubic Inches	—	3 71.3	—	—
2-Cyl. Horiz. Air Cooled Displacement, Cubic Inches	—	—	3 35.1	—
4-Cyl. Diesel Water Cooled Displacement, Cubic Inches	—	1 108	—	—
6-Cyl. Vee Water Cooled Displacement, Cubic Inches	—	—	—	1 107
4-Cyl. Vee Water Cooled Displacement, Cubic Inches	—	—	—	1 55
8-Cyl. Vee Water Cooled Displacement, Cubic Inches	—	—	1 131.7	—
2-Cycle Engines				
2-Cyl. Vert. Water Cooled Displacement, Cubic Inches	—	4 36.1	—	—
2-Cyl. Vert. Air Cooled Displacement, Cubic Inches	—	1 17.9	—	—
3-Cyl. Vert. Water Cooled Displacement, Cubic Inches	—	1 42.5	—	—

How They Are Put Together . . .

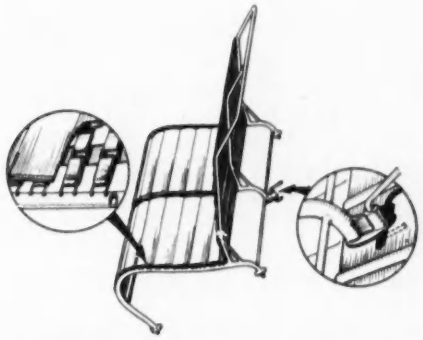


SMALL 2 CV Citreon has 94½ in. wheelbase, curb weight of 1200 lb, and 2-cyl, 23 cu in. aircooled engine.

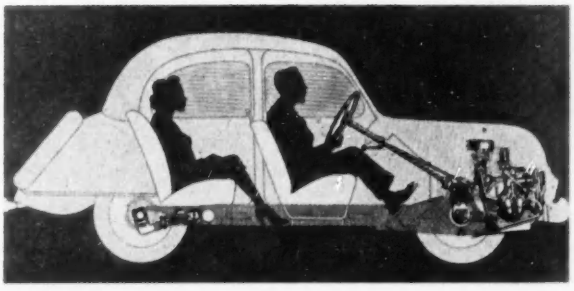


PLATFORM UNDERBODY and tent-like body shell of this front-drive passenger car.

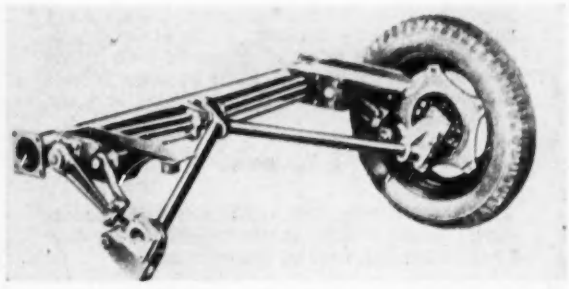
FRONT WHEEL ARM of the 2 CV Citreon. The canisters on the wheel arms contain sealed-in harmonic balancers to help keep the wheels on the ground.



SEAT FRAME CONSTRUCTION of the car is remarkably light. (This is motoring reduced almost to its lowest terms.)



CHASSIS in the Dyna Panhard is more or less conventional —an unusual feature in small cars. (This front drive car has a wheelbase of only 83 in. Curb weight is 1370 lb.)



REAR SUSPENSION is by torsion rods which operate on a peculiar V-shaped rigid axle. Front suspension is by transverse springs.

Olleygrams . . .

You don't so much get into some small European cars as you put them on like articles of clothing!

Average fuel consumption for small European cars is about 40 mpg, for small-medium cars about 30 mpg, and for medium cars about 25 mpg. Corresponding maximum level speeds are 45–55 mph, 55–65 mph, and 65–80 mph.

European industry is exploring along some lines which American industry has scarcely tried. Such things as the Mercedes swing axle, front drive, and 2-cycle engines certainly seem to demand attention.

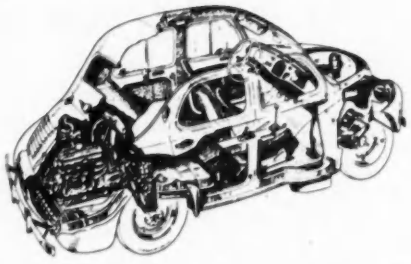
The American in the minicar feels humiliated and disgusted; in the British car he feels more comfortable but does not seem to be getting anywhere.

The Continental driver in the American car comes adrift on turns, cannot see around the corners of Alpine passes, and burns out his brakes.

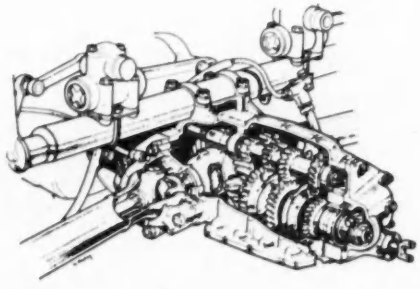
The European industry is realistic. It cannot rebuild cities all over the world to avoid the sort of congestion which afflicts downtown Detroit today. So it builds small vehicles that have some chance of weaving their way through cities as they exist.

The British motorist doodles along his lovely country lanes, admiring scenery and dodging obstacles almost subconsciously, with as much pleasure as the Continental driver tears around curves in his noisy minicar . . . or as an American strolls along at an effortless 70 mph in his vast boudoir on wheels. Each of them is well satisfied, but exchange their vehicles and see what happens!

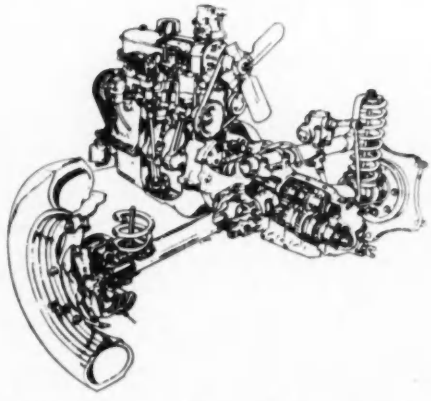
The world outside U.S. borders is being conditioned to the British and European rather than to the American type of post-war car.



ALL STEEL BODY of the 4 CV Renault, 4-door sedan is roomy for a car of this size.

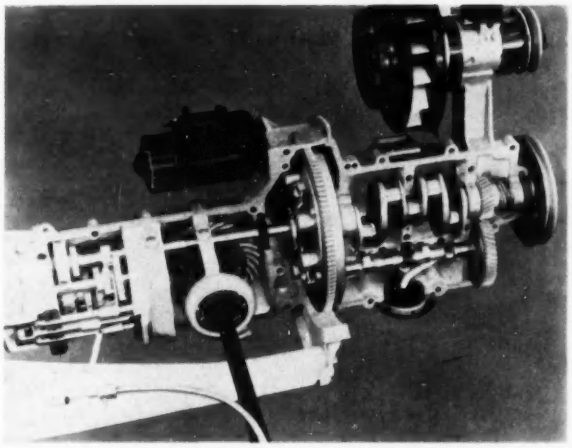


THREE-SPEED synchromesh transmission of this French car looks like this.

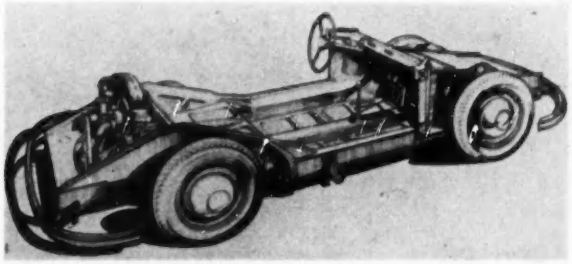


REAR SWING AXLE and complete powerplant of the 4 CV Renault. The engine is a 4-cyl, overhead valve, wet sleeve unit of only 46 cu in. displacement.

ENGINE IN THE REAR is a feature of the 1630 lb, 94½ in. wheelbase Volkswagen. The powerplant of this German car is a 4-cyl, horizontal aircooled engine.



DRIVE GEARS, clutch housing, engine crankcase and transmission of the Volkswagen.



PLATFORM UNDERBODY of the German Porsche is similar to that of the Volkswagen.

. . . Olleygrams

If it can be reasonably argued that only those human activities which prepare people for war and best insure their survival are logical, then more sports cars, driven at highest possible speeds, are desirable. This will sharpen wits of drivers with a view toward making them better soldiers, and accelerate the reactions of pedestrians so they will quickly adapt themselves to taking cover.

German 2-cycle engines appear to be immune to cylinder wear and contain a minimum number of parts requiring service.

European opinion of American cars for road holding is as low as American opinion of European cars for ride.

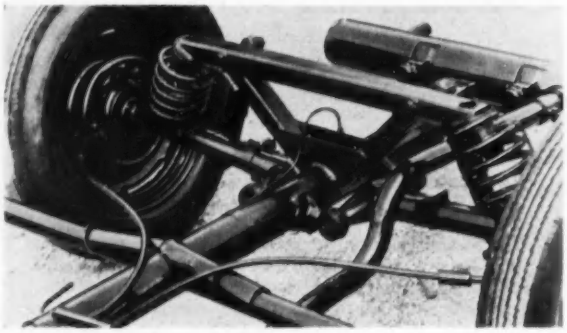
One must not judge European cars by American standards. They are not just funny little things used by people who don't know any better. The American car, if scaled down to dimensions necessary for European use, would not contain normal human beings.

The German Autobahn system, which allows sustained speeds, makes the 2-cycle engine possible and popular. This is bound to affect ideas of acceptable car styling.

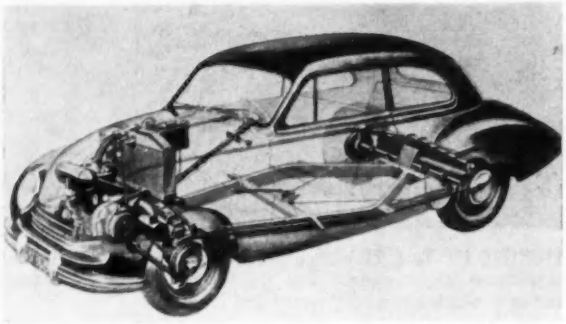
The Britisher in the American car feels that the car is a foot wider than the road he is driving on; in the minicar he has to shift gears at every sudden hill and blind turn.

Modern highways of the American type destroy irreplaceable farm land, and smaller European countries can't afford this. That's why European car designers have to keep their imaginations under restraint as regards mere size.

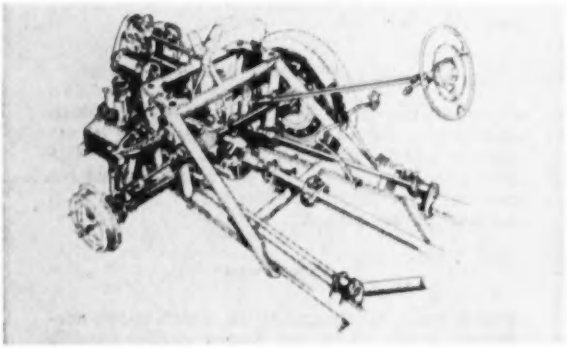
European cars are still ahead of the field in devising improvements in the conventional rear axle and in producing cars which run as though they were on car tracks.



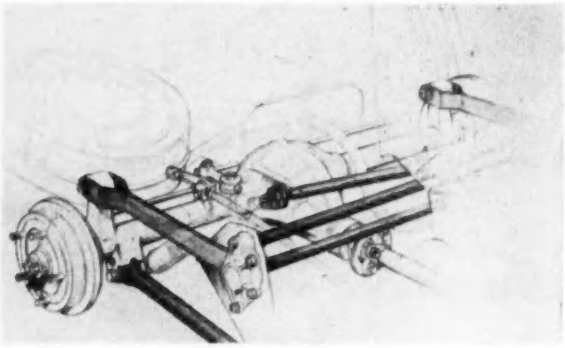
DEAD COIL-SPRING SWING AXLE and tubular backbone chassis used on the 79 in. wheelbase, 1520 lb, 2-seat German Gutbrod.



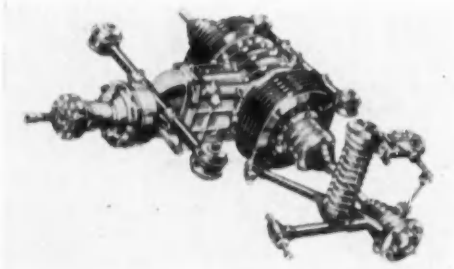
TRANSVERSELY is how the engine is mounted in this DKW front-drive sedan. Transverse leaf springs, a separate chassis frame, and a rigid rear axle are other features.



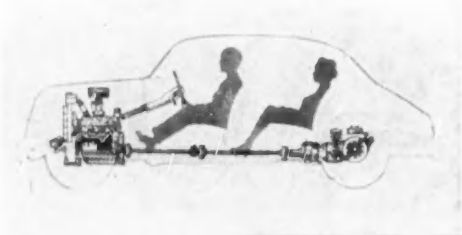
FRONT END construction of the Jowett Javelin with its 4-cyl horizontal engine and torsion rod wishbone suspension.



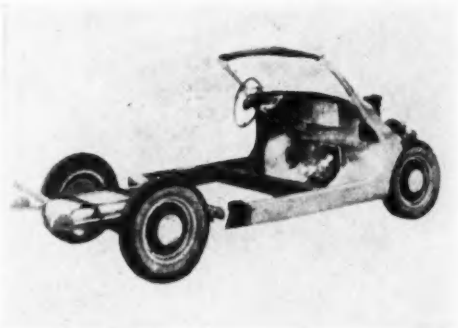
REAR END view of the same car shows how the rear axle and rear suspension are put together.



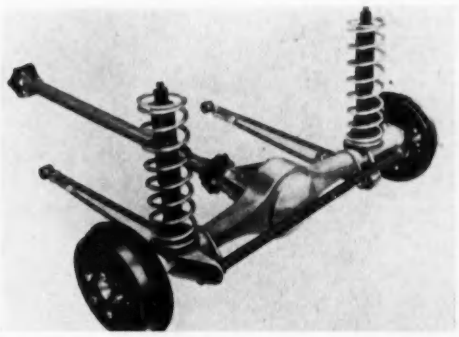
INDEPENDENT REAR SUSPENSION of the Lancia Aurelia is of the semi-swing coil-spring type. Note that the clutch and 4-speed gearbox are located at the rear also.



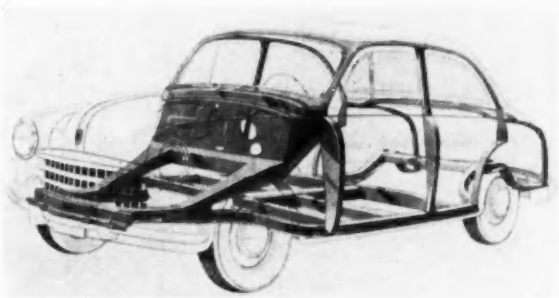
LOW FLOOR is a direct outgrowth of using rear-mounted clutch and gearbox. Rubber joints on the drive line and square dash corner are also made possible by this arrangement.



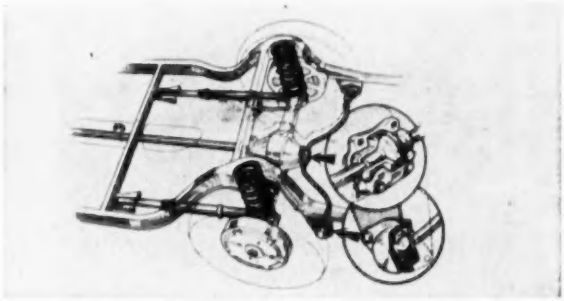
BODY-FRAME of the Hotchkiss Gregoire is constructed largely of light alloy castings, as are many engine and suspension parts.



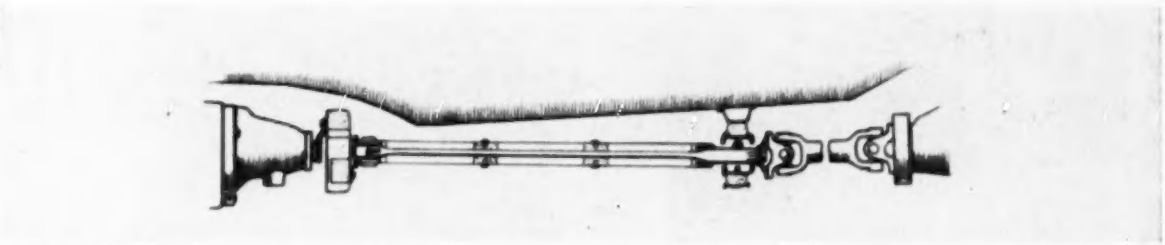
REAR AXLE of the Alfa Romero has rubber-mounted radius arms and a rubberized drive shaft which is useful in suppressing road noise.



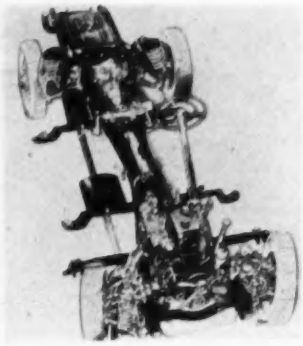
FRAMELESS CONSTRUCTION of the Italian-made Fiat 1400 is typical of that used on other post-war European passenger cars.



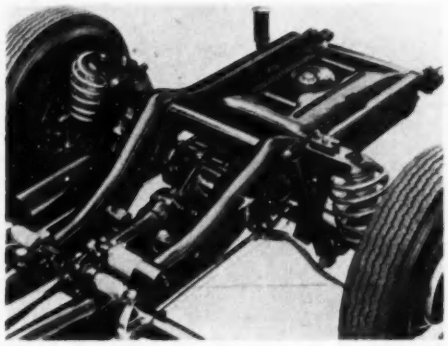
BENT STABILIZER BAR in the Fiat rear axle both centralizes the axle and acts to reduce spring rate. The cantilever leaf springs act only as radius arms.



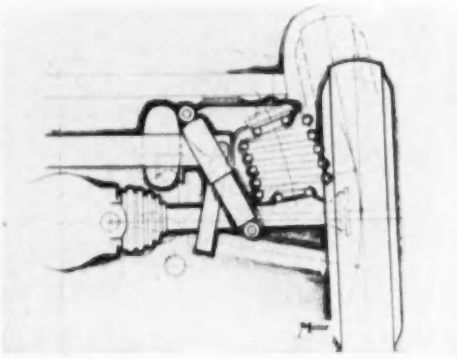
RUBBER COUPLING and light tubular mounting for the front half of the propeller shaft show the lengths to which Fiat has gone to reduce engine roughness and road noise.



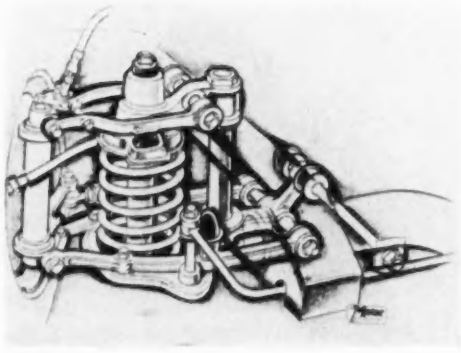
CHASSIS of a very large European car—the 120 in. wheelbase, 3700 lb, 183 cu in. displacement, 6-cyl engine Mercedes Benz 300. The frame is made of oval tubing and is waisted at the center with a box that completes the X construction.



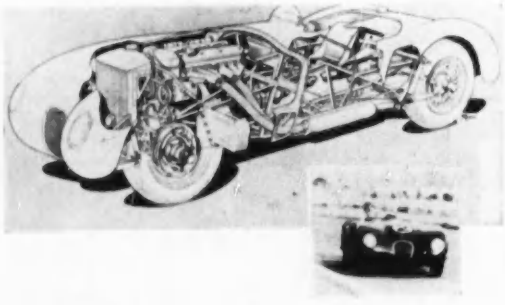
REAR END of the frame of this Mercedes shows the swing axle and the supplementary torsion rod. The latter enables the driver to adjust the spring rate and standing height of the vehicle, keeping the swing axle in a favorable position whatever the load in the car.



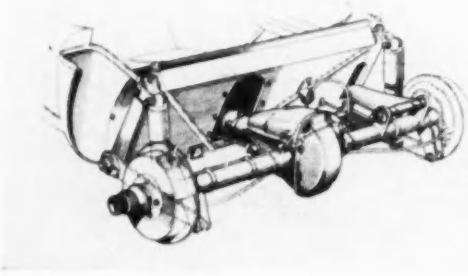
SWING AXLE on a typical Mercedes looks and operates like this.



FRONT SUSPENSION on Mercedes cars. Note the anti-shimmy mounting of the wishbones.



SPORTS CAR CONSTRUCTION—This shows a cutaway view of the Jaguar XK 120C.

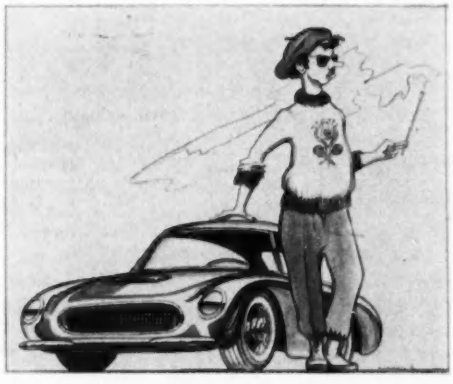


LINKAGE on the rigid rear axle of the Jaguar neutralizes transverse torque.

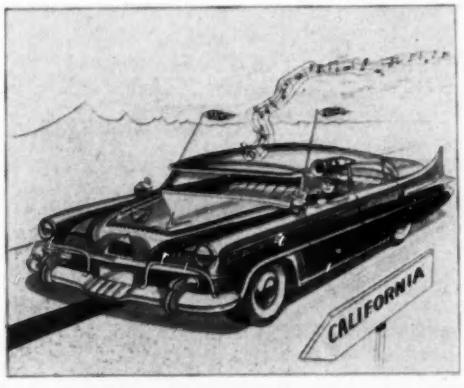
But European or U.S., Cars Are Built . . .

To Fit Special Cases . . .

NARROW British cars are tailored for ease in navigating narrow British roads.

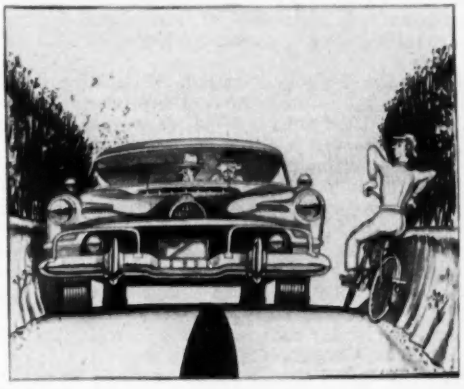


SMALL, cheap-to-operate cars that hold the road well are what Continentals want.

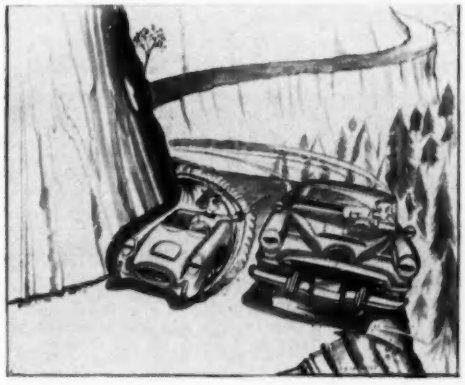


LUXURY, comfort, and high speed top the list of things an American demands in his car.

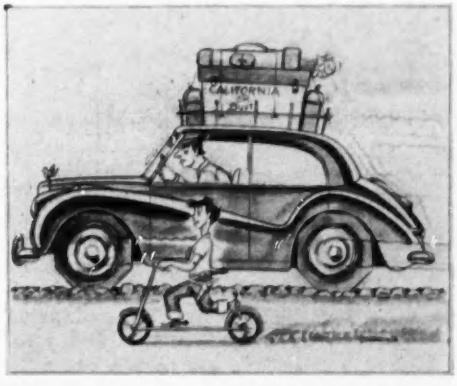
Not To Swap Places



BROAD American cars cause big squeeze when transplanted to British soil.



LARGE American cars sent abroad really miss those straight, wide U.S. roads.



AUSTERITY, rough ride, and low speed sum up an American's impression of a European car.

What A Discusser Learned about European Cars . . .

H. A. Toulmin, Ethyl Corp.

LAST summer Ethyl purchased a 1952 Jaguar XK 120 fixed-head coupe so we could determine the characteristics of its very high specific output engine when operated on highly sensitive fuels. In this discussion, some of the performance characteristics of this automobile will be compared with those of a high-performance 1952 U.S. production car.

Fig. A shows the Jaguar tested. Frontal area and general lines are quite low compared with those of U.S. cars.

The car is fitted with a 6-cyl, valve-in-head engine of double overhead camshaft construction. Bore and stroke are 3.27 and 4.17 in., respectively, giving a total displacement of 210 cu in. It has a hemispherical combustion chamber similar to that used by Chrysler and a standard compression ratio of 8 to 1. With the high-lift camshafts and dual exhaust system used in our Jaguar, the engine develops 180 bhp at 5300 rpm and 203 lb ft torque at 4000 rpm. The car has a 4-speed manually operated transmission (synchromesh in second, third, and fourth gears), together with a rear axle ratio of 3.64 to 1. Curb weight with a full tank of gasoline is 3075 lb.

Expressing these specifications another way, it might be said that the Jaguar is about 300 lb lighter than a standard Chevrolet and has an engine of 6 cu in. smaller displacement.

Fig. B shows a comparison of the acceleration characteristics of the sports car and the high-performance U.S. car. While Jaguar engine speed for a given car speed is higher, Jaguar acceleration performance is maintained over a wider speed range and is superior to that of the U.S. car at practically all speeds. In fourth gear, for example, performance of the Jaguar is approximately 30% better than that of the American car at speeds from 50 to 80 mph. Above 80 mph, Jaguar performance excels by an even greater margin.

Fig. C shows the comparative performance of the two cars while accelerating through the gears, starting from rest. The Jaguar has only a slight advantage up to 40 mph, but from this speed upward the difference becomes progressively greater.

Fuel economy comparisons are shown in Fig. D. Fuel economy of the Jaguar is better than that of the high-performance American car. However, this is not a fair comparison as the frontal area of the U.S. car is greater and its test weight 1500 lb more. Comparing Jaguar economy to that of a U.S. car of approximately the same displacement and only slightly greater weight, it is seen that the American car is more economical than the sports car at low speeds. Poor economy of the Jaguar at low speeds can probably be attributed to the fact that the fuel/air ratio was kept about the same for both road load and full load.

As for octane number requirement of the Jaguar engine, it is very low at low engine speeds and peaks at 83 octane number at approximately 3200 rpm. (This requirement was obtained after the car had been driven at high speeds during the performance tests. It does not represent the maximum requirement of the vehicle.)

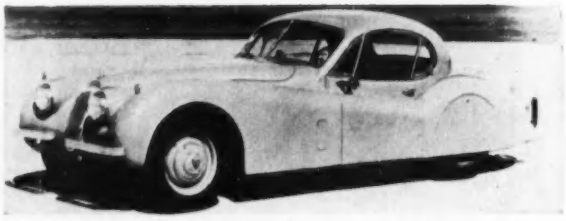


Fig. A—The Jaguar XK 120 has low lines and a low frontal area

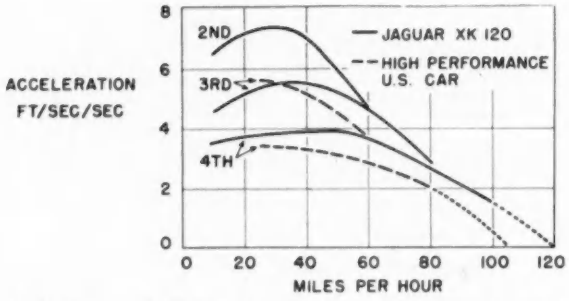


Fig. B—Jaguar acceleration performance is superior to that of a typical high-performance U.S. production car at practically all speeds

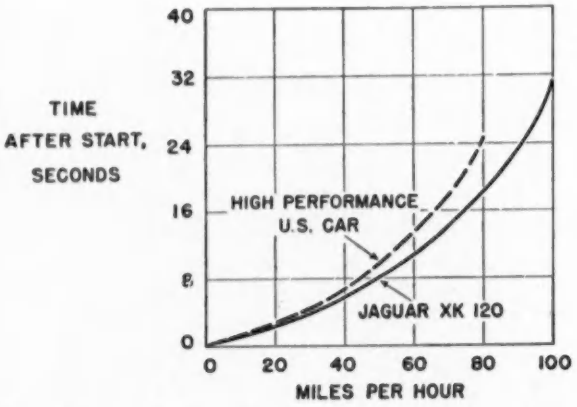


Fig. C—Accelerating through the gears from rest, the Jaguar shows progressively better performance than a typical high-performance U.S. car

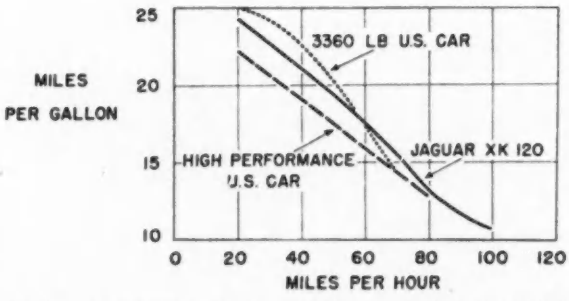


Fig. D—Fuel economy of the Jaguar is better than that of a typical high-performance American car because of its lower frontal area and lighter weight

Plastic Radomes

Pass the Beam

But Shield the Radar

THE radomes that house delicate aircraft radar units aren't the simple-to-fabricate shells they might seem. They have to satisfy a number of electrical as well as structural requirements.

Radomes are formed of bonded layers of glass-fiber-reinforced plastics. These materials transmit a high proportion of the electromagnetic radiation, neither absorbing nor reflecting it. Nor do they deflect or distort the radar beam if the radome is properly designed and fabricated. Reinforced plastic radomes withstand air loads, rain, gun blasts, and heat reasonably well. And they can be protected by ethylene glycol spray against ice accretions which would otherwise interfere with radar functioning.

How They're Made

Basic steps in radome manufacture, as explained in Figs. 1–4, are:

1. Saturating the glass fiber material with the resin.

2. Laying layers of the impregnated material in or on the mold.

3. Applying enough pressure to keep the layers in intimate contact and heating until the resin cures hard.

4. Trimming to size.

5. Spraying the outer surface of the radome with a protective coating. (Subsonic radomes destined to face into the airstream usually receive a 0.010-in. coat of neoprene rubber. Other radomes are lightly enameled.)

A few radome designs call for two skins made by this procedure, separated by an air space. Other radomes are sandwich structures (Fig. 5) consisting of two laminated skins stiffened by an intervening layer of glass-fiber honeycomb or foamed-in-place plastic. The whole sandwich may be cured at once. Or the skins may be cured separately, then their

The accompanying article is based on the papers:

Radome Optical System Problems on Supersonic Aircraft
by W. Garcia
Consolidated Vultee Aircraft

Radome Anti-Icing Tests — Instrumentation Problems Encountered
by C. A. Gibbons
Northrop Aircraft, Inc.

Design of Radomes Resistant to Gun Blast
by H. A. Hummel and A. S. Leipzig
Douglas Aircraft Co., Inc.

A Method of Ice Protection for Radomes
by F. E. Lenherr
Northrop Aircraft, Inc.

The Effect of Radomes on Missile Guidance
by E. T. Philips
Ryan Aeronautical Co.

Problems Associated with the Manufacturing of Radomes
by J. A. Sporcic and R. L. Whann
North American Aviation, Inc.

These papers were presented at a symposium on radomes at the SAE National Aeronautic Meeting, Los Angeles, Oct. 2, 1952. The complete papers are available in multilithographed form from SAE Special Publications Department at 25¢ each paper to SAE members and 50¢ to nonmembers.

How Radomes Are Made . . .

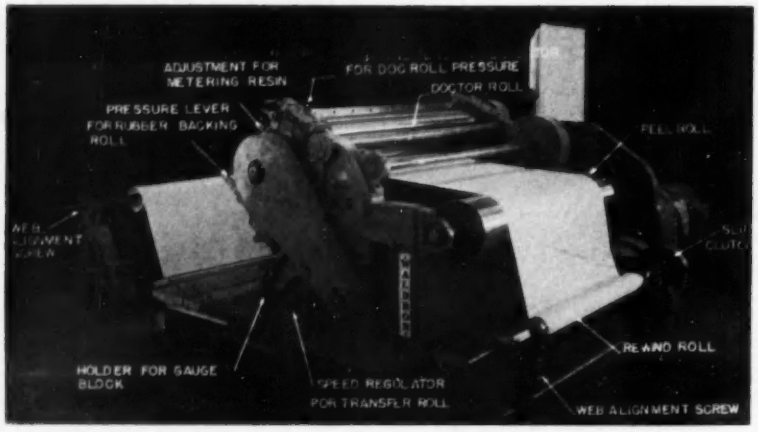


Fig. 1—Impregnation of the glass-fiber cloth or mat with resin is the first step in radome fabrication. North American does it with this machine. Resin application must be exact and uniform

Fig. 2—Sharp blade and template are used to cut impregnated glass fabric to shape by hand. Or shape may be blanked out with steel rule die.

Fig. 3—Into the mold goes the fabric, layer smoothed on layer. The die is closed, applying 10-50 psi pressure to hold layers together, and heating begins

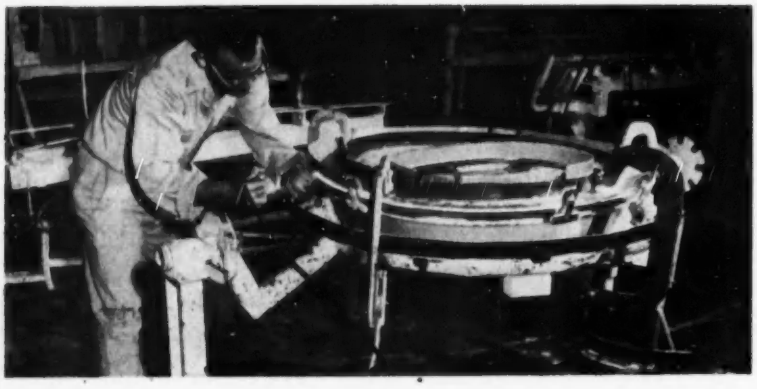


Fig. 4—Trimming is done after cure. Currently used polyester resins cure within the time-temperature range defined by at least 90 minutes at 190 F, 45 minutes at 200 F, or 10 minutes at 240 F. Cured shell can be drilled, sawed, milled

mating faces roughened and bonded to the honeycomb.

Twin concerns in radome manufacture are how to insure that the radome is of uniform thickness and composition and that it won't delaminate. Any precaution that keeps impurities away from raw materials and materials in process or in storage helps.

Separate molding of sandwich faces generally favors uniformity. The thinner layers make it easier to find and smooth out wrinkles and to keep thickness variations within the ±0.003-in. range which is typical for radome tolerances. Also, if the outer face is molded and cured separately, an extra "tear-off ply" of fabric can be added on the inside. When this is pulled off, it exposes the areas where excessive resin might collect and leaves a surface rough enough to need no sanding before bonding to the core.

Sandwich structure radomes with honeycomb cores made in one cure almost always show surface pits corresponding to the core cells, North American has found. Surface irregularities make it very difficult to apply the neoprene protective coating. And at high speeds rain may erode the poorly protected areas in much the same manner as sand blasting would.

However, single-cure sandwiches are less likely to delaminate from gun blast, Douglas discovered in working with radomes for gun-aiming radar. The pre-cured faces don't adsorb enough of the secondary bonding agent to form good fillets with the cell walls of the honeycomb.

Douglas engineers have also uncovered five other means of minimizing delamination of face and core and tearing of the outer glass fabric:

1. Stitch together the glass cloth layers forming the outer face of the sandwich. (A ½-in. crosshatch pattern works well.)

2. Keep radomes small.

3. Avoid flat or hollowed areas on the radome.

4. Use blast reducers. (See Fig. 6.)

5. Take into account that the area of maximum blast advances as the gun wears. (A new gun produced maximum blast 10 in. forward of the gun port. The same gun after use had its area of maximum blast 28 in. forward of the gun port. Maximum pressures were of about the same magnitude before and after use.)

Dielectric as well as structural requirements influence the choice of radome construction. For supersonic airplanes and missiles, single-skin half-wave-thick radomes are usually used instead of sandwich-structure radomes. That's because the optimum sandwich radome would have the core dielectric constant equal to the square of the skin dielectric constant. But with high-dielectric-constant core and low-dielectric-constant faces, sandwich structures have less favorable strength/weight and stiffness/weight ratios than solid structures.

Besides, for the sharply pointed radomes required for most supersonic aircraft, homogeneous walls have better transmission efficiency, less relative

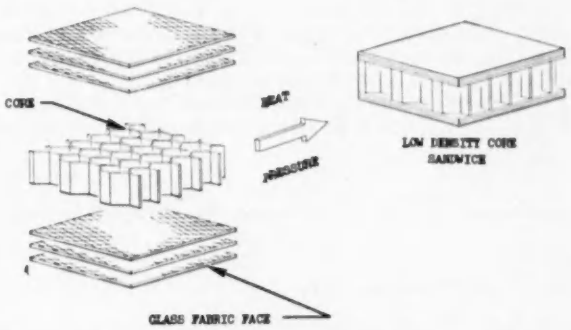


Fig. 5—Layers of glass fabric saturated in resin make up sandwich skins. Core is usually glass fiber formed into honeycomb to give high longitudinal sheer strength relative to weight. Skins may be pre-cured, then bonded to core. Or, in the "wet lay-up" method, the whole sandwich is cured in the same cycle. Sandwich structures are also made by curing the two skins separately, bringing them together, then injecting foamed-in-place plastic. But this method is said to be more expensive, at least at present

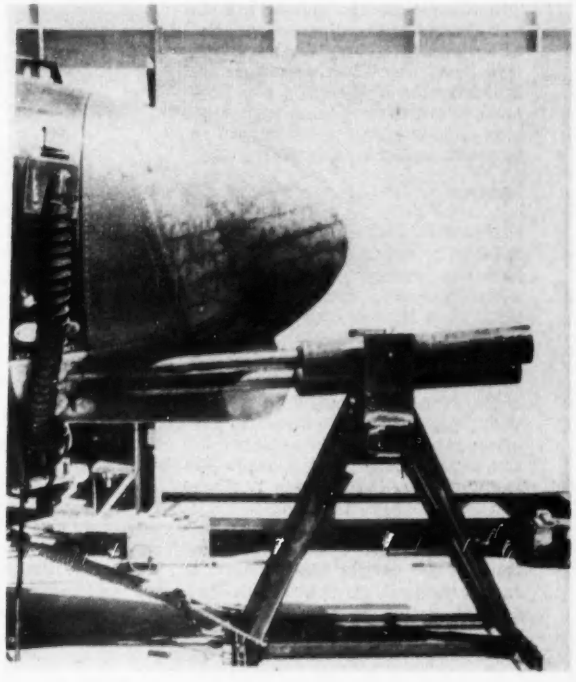


Fig. 6—Underslung radome with blast shields. (Radome is small lighter-color protuberance below nose. Blast reducers are tubes resting on triangular support used for tests)

phase shift, and elliptical polarization values nearer unity.

Of course, dielectric constants of sandwich core materials of given thickness could be raised if titanium dioxide were added to the resin or glass fiber. But this step would reduce thickness tolerances on the core material to levels too low to maintain in present manufacturing processes.

Choice of resinous material for supersonic radomes, as well as type of structure, must be carefully considered. Aerodynamic heating can easily raise radome temperatures above 200 F, into the range where some resins deteriorate. Resins chosen must have enough heat conductivity and heat-resistance to preclude softening, deflection, chemical change, and combustion—any of which would alter radome electrical characteristics.

At the other end of the temperature scale is the problem of ice accretions—which also change the electrical characteristics of the radome. Fig. 7

How the Radome Can Affect Missile Guidance . . .

Guidance and response of a missile with a radar seeker antenna in the nose are affected by these electrical characteristics of the radome:

Transmission efficiency — The ratio of transmitted microwave power to the incident power, which is the transmission efficiency, is never unity for real radome materials. The radome always reduces the emitted power somewhat, thereby decreasing the range of the missile. But because of the inverse fourth power law in the radar range equation, the effect on acquisition range is much less than the effective power reduction. For this reason it is possible to sacrifice radome transmission efficiency to some extent to improve on other characteristics.

Reflection effects—Excessive reflection of transmitter power back into the antenna, although small percentage-wise, can make a large difference in the load impedance presented to the transmitter—and may cause frequency pulling or the cessation of oscillations altogether. If the radome and antenna vibrate with respect to one another, the effect may be to raise substantially the microphonic noise level in the radar seeker. This tends to mask the target signal. If a continuous-wave or frequency modulated radar set is used, reflections from the radome couple directly to the radar receiver, so that additional care in design is needed in such cases.

For most types of radome construction, the degree of reflection depends both upon the angle of incidence and the orientation of the polarization vector of the electromagnetic energy. This, of course, complicates the requirement of minimum reflection, since the radome must satisfy this condition for a wide variety of incidence angles and relative polarization vector orientations.

Multiple reflection within the radome and inside the radome walls itself tends to raise side-lobe level and shift the radar beam.

Refraction and diffraction—These effects cause the missile's tracking radar to gather wrong information on relative target position and movement, so that the commands given to the missile control system are in error and the missile makes erroneous maneuvers.

The control rate effects produced by radome beam bending are often as important as the erroneous position information. That's because some missiles are guided by information on relative missile-target angular velocity as well as by relative missile-target position. Relatively small magnitudes of radome beam bending can easily cause large errors in angular rate measurement. Furthermore, if the beam bending changes with antenna gimbal angle, the rate errors may be of different sign for different gimbal angles, thus affecting greatly the missile's control ratio.

It is possible with moderate radome refraction, to change the control ratio of a missile to such an extent that it becomes unstable. The effect would be either that the missile would follow an erratic, oscillatory path or that it would cease to home on the target altogether because of hypersensitivity to noise caused by the increased effective control ratio. For regions of the radome where refraction causes the effective control ratio to be reduced, the missile may lack the ability to follow target evasive maneuvers.

The effects of polarization complicate the radome refraction problem because of the asymmetry of the polarization with respect to the radome. This causes the refraction function to be different in the up-down gimbal plane than it is in the left-right gimbal plane, so that it becomes more difficult to design the guidance system and radome to obtain acceptable navigation.

These same electrical characteristics do also, of course, affect other kinds of airborne radar, like the units for search, homing, interception, or gun-laying—whether the radomes extend from the airplane skin or mount flush with it.

shows the ice built up on a radome after a 15-minute run in the NACA Icing Research Wind Tunnel. This is typical of the ice built up on radomes in flight. Fig. 8 shows the lowering of transmission efficiency as the ice formed during the test. Ice accumulated during short periods of flight through clouds containing supercooled water drops may persist for several hours, interfering seriously all the while with radar performance.

Spray De-Icing Used

At least two manufacturers of radomes, Northrop and Lockheed, have used ethylene glycol spray de-icing systems. In the Northrop system fluid flows from a tank behind the radar equipment through a vinyl tube on the inner surface of the radome to a spray nozzle at the leading edge of the radome. The ethylene glycol mixes with the impinging water, depressing the freezing point of the mixture below the radome surface temperature. The mixture runs back over the radome, blowing off or freezing at some point farther aft.

The ethylene glycol spray system does not weaken the structure or necessitate radome redesign. It does, however, alter the electrical properties of the radome somewhat, as shown in Table 1. The spray system also adds weight—the weight penalty increasing with flight angle of attack, airspeed, and coldness.

Douglas has tried circulating heated-air de-icing of sandwich-type radomes. So has North American —and found it performs well but is hard on structure. The heated air tends to destroy the bond between core and skins if they have been cured separately. A single-cure fabricating method has given better results. In this method, the fabric for the core is wrapped around wax rods. Then core and uncured skins are pressed together and polymerized in a single, relatively long cycle.

Research on anti-icing as well as on other problems associated with radomes continues, so that radomes for future higher-speed aircraft will satisfy tighter electrical requirements and still withstand the stepped-up aerodynamic loadings and skin-friction heating.

Table 1—Average One-Way Transmission Efficiency and Beam Deflection for Point of Maximum Error for Parabolic and Hemispherical Radome Specimens

	Transmission Efficiency, %		Deflection, mils	
	Parabolic Radomes	Hemi-spherical Radomes	Parabolic Radomes	Hemi-spherical Radomes
Radome alone	94	98	5.0	0.9
Anti-icing installation alone	89	94	5.3	0.9
Ethylene glycol film alone	87	89	5.0	0.2

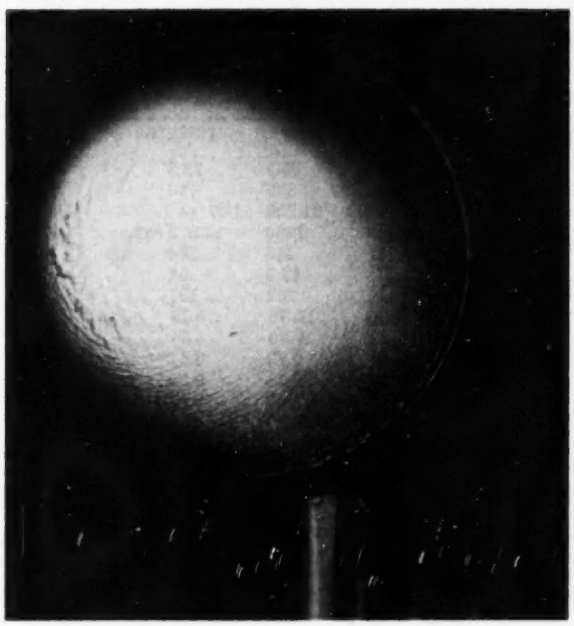


Fig. 7—Radome accumulated this ice in a 15-minute run in the NACA Icing Research Wind Tunnel at Cleveland. Ice formation was asymmetric, being concentrated in the lower portion in the foreground. Nose had ¾ in. of semi-glaze ice

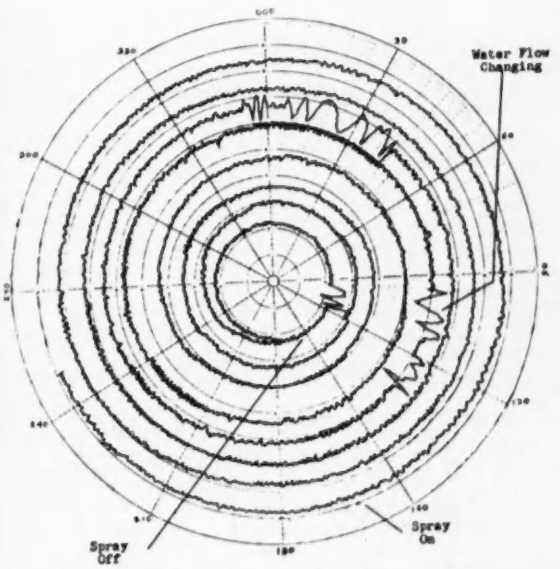


Fig. 8—Ice accretion in Fig. 7 produced this decrease in transmission efficiency during the 15-min test run. Tunnel air speed was 275 mph; tunnel temperature was −5 F. Azimuth and elevation planes were 0 deg

Synthetic Lubricants

POLYPROPYLENE-glycol synthetics have many advantages as lubricating oil for automotive engines operated in cold weather.

They are made from readily available materials, there are no major difficulties in their manufacture, and they are relatively inexpensive as compared to other synthetics of comparable physical and chemical properties. Very high viscosity index oils can be produced over a wide range of viscosities.

These oils are unusual in that the volatility characteristics of low-viscosity polypropylene glycols are similar to those of relatively high-viscosity mineral oils. This is illustrated in Table 1 in which the physical properties of several polypropylene-glycol synthetic oils, and blends of the synthetic oils and mineral oils, are compared with conventional crankcase lubricants of the same viscosity grades. For example, we have found that the vola-

Table 1—Properties of Synthetic Oils and Synthetic-Mineral Motor Oils

	Synthetic Oils			Mineral-Oil Blending Stocks		Synthetic-Mineral Motor Oils		Conventional 5W Motor Oil
	A	B	C	1	2	A & 1	A & 2	
SAE Viscosity Grade	5W	5W	10W/30			5W	10W/20	5W
Gravity, deg API	14.8	12.3	9.8	30.9	29.2	23.5	22.2	26.7
Flash Point, F	390	390	420	290	420	325	410	315
Viscosity at −30 F, SSU (measured)	15,000	20,000	—	—	—	21,200	—	93,246
Viscosity at 0 F, SSU (measured)	2100	3000	11,700	1570	55,000 ext.	2980	10,800 ext.	4897
Viscosity at 100 F, SSU (measured)	86.8	121	239	73.3	401	110	252	139
Viscosity at 210 F, SSU (measured)	39.8	45.7	60	36.7	57	43.2	54	45.7
Viscosity Index	165	167	150	64	91	162	127	149
ASTM Pour Point, F	B–70	−60	−60	−40	5	B–70	−35	B–70
Stable Pour Point, F (undiluted)	B–70	−60	−60	−40	5	B–70	−25	−65
Conradson Carbon, %	0	0	0	0	0	0.30	0.51	0.44
Ash, %	0	0	0	0	0	0.25	0.37	0.32
% Distilled at 480 F,[a] 5-MM Hg	32	< 20	< 5	94	6	69	16	More than 80
Oil Miscibility Temperature,[b] F	−15 to B–70	−35 to +25	+40 to +100	—	—		—	—
Performance Characteristics								
Minimum Pouring Temperature, F	B–70	B–60	B–60			B–70	B–25	B–65
Minimum Starting Temperature, F	−30	−28	−15			−28	−15	−17
Oil Mileage Relative to Mileage of SAE 10W Oil (100 V. I.)	103	156	216			92	204	61

[a] ASTM D-1160.

[b] Temperature of phase separation—equal volumes of synthetic and various mineral oils.

for Winter Operation

J. A. Miller and H. F. Galindo, California Research Corp.

Excerpts from paper, "Case for Synthetic Lubricants in Winter Operation of Automotive Engines," presented at SAE Fuels & Lubricants Meeting, Tulsa, Nov. 7, 1952.

tility characteristics of synthetic oil "A" with a viscosity of 39.8 SSU at 210 F are approximately the same as those of a 55 SSU naphthenic oil with a viscosity index of 55 (not shown in Table 1). The heavier grades of the synthetic oils, of course, are essentially nonvolatile under these distillation conditions.

The high viscosity index and low volatility of properly inhibited polypropylene-glycol lubricants provide adequate low-temperature starting and, at the same time, suitable protection for satisfactory operation at high temperatures.

When properly inhibited, these oils also have good oil consumption characteristics. Moreover, on oxidation, this type of synthetic oil has the unusual property of forming volatile products in contrast to the high-molecular-weight polymers or sludges of conventional mineral oils. This type of oxidation, however, leads to high oil consumption unless proper inhibitors are incorporated in the synthetic oils. Fig. 1 illustrates the oil consumption characteristics of the uninhibited synthetic oil as compared to properly inhibited synthetics in which the oil consumption characteristics are markedly improved by preventing oxidation.

Another desirable feature of certain polypropylene-glycol synthetic oils is that, in the low viscosity range, they are miscible with mineral oils. This oil miscibility, therefore, permits the use of these synthetics as blending agents for low-temperature oils that retain most of the excellent physical properties of the synthetic oils. In addition, these blends can be effectively compounded with conventional additives.

The polypropylene-glycol synthetics possess excellent natural detergency in controlling gasoline-engine deposits. For example, the 10W/30-grade synthetic oil showed a piston varnish rating in a Chevrolet FL-2 test of 5.2 when tested with a gasoline that produced pistons having varnish ratings of 2 to 3 when MIL-0-2104 oils were used as lubricants. The detergency of these synthetics is not as good in diesel engines. However, by blending these synthetics with selected mineral oils it is possible to add conventional compounding to the blend and produce an oil satisfactory for diesel engines with regard to control of engine deposits and wear. Since these synthetic oils contain no wax, and pour point is limited by viscosity only, they are not subject to pour-point stability problems, nor will the low pour points of these oils be lost in engine use.

Winter-Grade Oils

The effect of ambient temperature on cranking speed for various conventional and synthetic crankcase lubricants is illustrated in Fig. 2. The chart

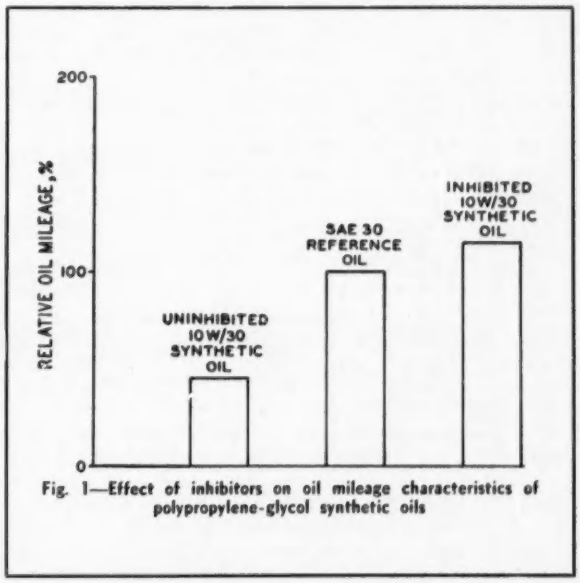


Fig. 1—Effect of inhibitors on oil mileage characteristics of polypropylene-glycol synthetic oils

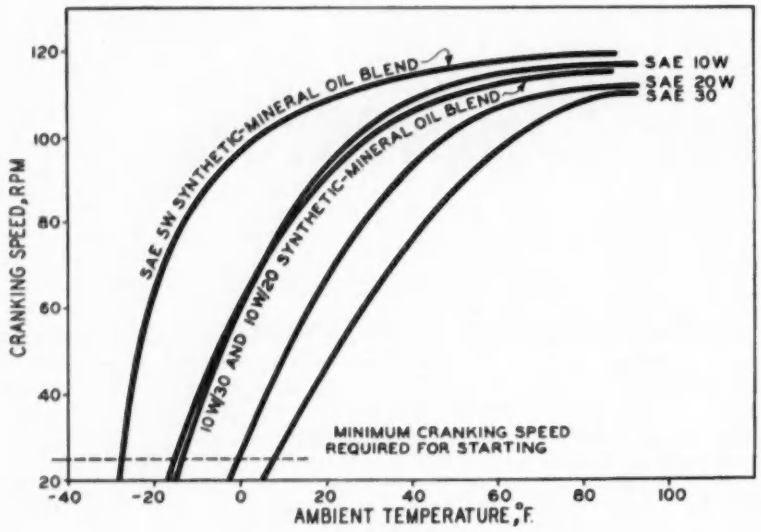


Fig. 2—Effect of ambient temperature on cranking speed for various conventional and synthetic crankcase lubricants

shows estimated cranking speeds that will be obtained in an average passenger-car engine at various ambient temperatures with the battery at that temperature. Conventional oils in the SAE 10W, 20W, and 30 grades are compared with synthetic oils or synthetic-mineral oil blends of the same viscosity grades. For example, a synthetic oil with the high-temperature properties of an SAE 30 oil will permit starting at – 15 F, while the conventional SAE 30 oil will not permit starts below 5 F. It should be pointed out that the relationship between ambient temperatures and cranking speeds is also valid for mineral oils of comparable viscosity index.

The high viscosity index and low volatility of certain polypropylene-glycol synthetic oils provide oil mileage which, particularly in the 5W range, cannot be obtained from conventionally refined viscosity index improved mineral oils. Relative mileages of conventional winter-grade oils are compared with those of polypropylene-glycol synthetic

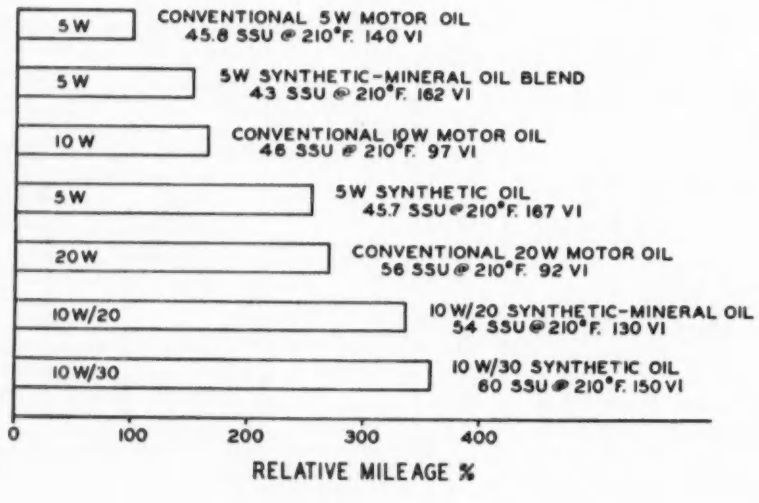


Fig. 3—Relative mileage of conventional and synthetic winter-grade crankcase oils

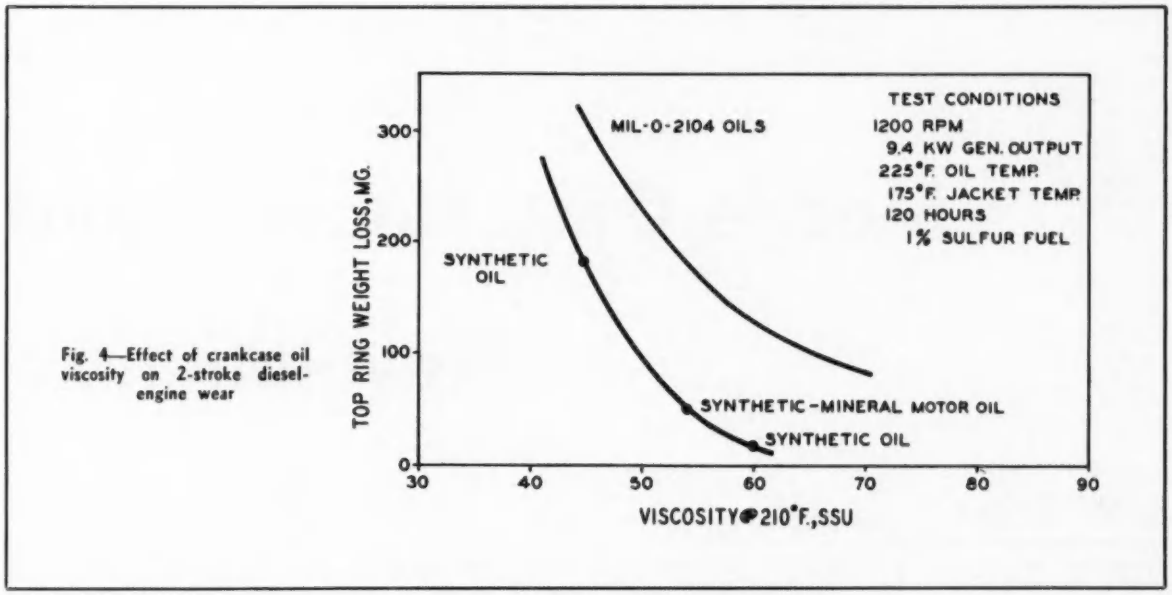


Fig. 4—Effect of crankcase oil viscosity on 2-stroke diesel-engine wear

oils and blends of synthetic and mineral oils in Fig. 3. In this illustration the mileage of a conventional 5W oil having a viscosity of 45.8 SSU at 210 F and a viscosity index of 140 was selected as 100%. The mileages obtained with the various synthetic oils and mineral oil blends are shown as a percentage of that mileage. Data on the synthetic-mineral oil blends were obtained in field tests including civilian and military vehicles.

Alaska winter operation of heavy-duty gasoline, and diesel-powered vehicles has shown that, in most cases, conventional 5W oils are adequate lubricants as far as control of low-temperature engine wear and deposits is concerned. In certain cases, however, it was found that the use of low-viscosity lubricants causes excessive engine wear. We have found that, under high-load conditions, the polypropylene-glycol synthetics and synthetic-mineral oil blends are very effective in minimizing high-temperature engine wear. Single-cylinder 2-stroke diesel-engine tests using 1% sulfur fuel were conducted to evaluate this property. The effect of crankcase oil viscosity on wear in this test engine is illustrated in Fig. 4. The upper curve shows the top-ring weight loss in milligrams obtained in the test when SAE 10W, 20W, and 30 oils were used as lubricants. These oils were of the MIL-0-2104 type. The reduced ring weight losses when the engine was operated on synthetic oils and synthetic-mineral oil blends of equivalent viscosities at 210 F are shown on the lower curve. This beneficial wear effect of the synthetic oils is probably a combination of viscosity and volatility factors and has been confirmed in field tests in both gasoline and diesel engines.

Conclusions

An excellent universal winter-grade crankcase oil can be formulated through the use of polypropylene-glycol synthetic oils. Such an oil, in the 5W grade, has demonstrated satisfactory performance in Alaska and the colder areas of the United States and Canada. There are, of course, advantages for this type of oil, even in milder climates, because of quicker starts and the subsequent relief afforded to the battery as well as the improved fuel mileage obtained through the use of a lighter oil. Satisfactory control of oil mileage and high-temperature engine protection using synthetic oil blends have been substantiated in field tests, including those in military vehicles. These oils were formulated to permit starting under extreme winter temperatures and yet provide oil mileage comparable to that obtained with summer-grade lubricants. This type of oil will also flow freely under extremely low-temperature conditions and will provide adequate protection against wear, rust and engine deposits. By proper combinations of synthetics and mineral oils, conventional additives can be employed to give any degree of diesel-engine performance desired as defined by current service requirements. The synthetics, however, are still somewhat higher in cost than mineral oils, but their desirable properties can be utilized to good advantage. They may be considered excellent blending agents or additives to achieve the particular service required.

There has been some reluctance to use low-viscosity winter-grade lubricants because of poor experience with certain inadequate products in automotive engines. Unless the engine operator receives adequate high-temperature engine protection, the low viscosity winter-grade lubricants will not receive the public acceptance they so justly deserve.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Mobile Gate House Could Revolutionize

E. W. Fuller, Director of Staff Engineering, American Airlines, Inc.

Excerpts from paper "A Proposed Mobile Gate House" presented at the SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1952.

Mobile Gate House Plan Contrasts with Conventional Design

THE mobile gate house and air terminal planned to use it form one alternative to conventional-type terminals.

Conventional passenger terminal design requires the positioning of aircraft in a passenger terminal area, the size of which is determined by the airplane parking areas.

If we continue with passenger terminals of this type as the industry continues to expand, the terminal area must expand. Such expansion often involves the addition of costly concrete aprons which duplicate base facility aprons required for overnight and turnaround maintenance. Covered walk facilities or passenger loading fingers must be provided for the long inconvenient walks required of passengers boarding planes. Such expansion reduces the passenger mass density in the concessions area. This, in turn, reduces its attractiveness to the concessionaire upon whom the municipality and airline must depend to absorb a portion of the operating cost of the airport.

In contrast, the mobile gate house plan offers these advantages:

1. Passengers will not have to walk long distances to their aircraft, nor will they be exposed to inclement weather at any time.
2. Operating costs are less.
3. Jet aircraft can be removed from the immediate terminal area.
4. Passenger baggage can be scheduled to arrive at the terminal area ahead of the incoming passengers.
5. Concessionaires can all be located in the central terminal building and since passengers, except during the time they are moving to and from the aircraft, will be concentrated in that area, some increase in concessionaire business should result.
6. Due to the fact that aircraft will not have to be removed from the passenger terminal to the base facility area, some tangible increase in aircraft utilization may be possible.
7. Financial savings over and above those enumerated here will undoubtedly result from the combination of base maintenance facilities and gate maintenance facilities.

Airport Design

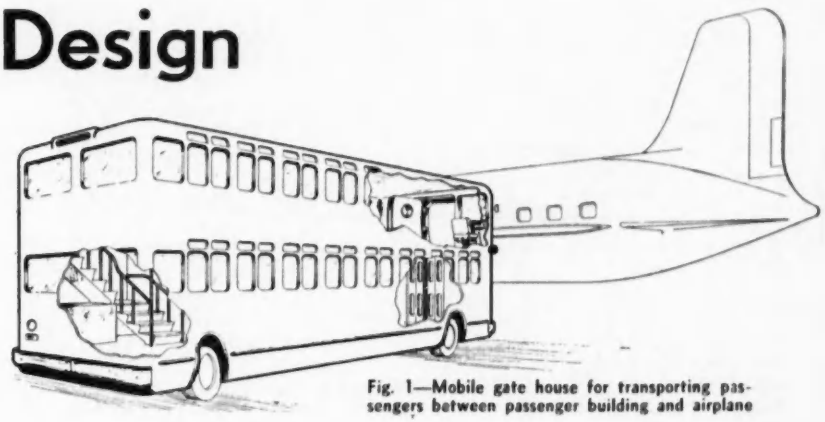


Fig. 1—Mobile gate house for transporting passengers between passenger building and airplane

MOBILE gate houses like that shown in Fig. 1 would simplify airport operation and make it possible to:

1. Use the airport base facility area for both servicing and passenger loading and unloading.

2. Eliminate the terminal apron area—which would decrease airport operating cost and increase aircraft utilization.

Fig. 2 shows an airport planned for operation with mobile gate houses. The parking and servicing areas are close to the runway. There is no costly duplication of concrete aprons around the passenger building at the left of Fig. 2.

Outgoing passengers enter the central terminal building, check or claim their baggage or buy tickets, and enter the mobile gate house. Ten minutes before departure, the mobile gate house transports the passengers to their aircraft and they enter it directly.

Reversing this process, 10 minutes after aircraft arrival on the apron at the right, the mobile gate house delivers the passengers at the terminal building. The mobile gate houses and all baggage tractors are dispatched by two-way radio-telephone.

The mobile gate house shown in Fig. 1 is a double-deck vehicle built on a standard bus chassis. It is 39 ft long, 15½ ft high, and weighs 28,000 lb empty. (By comparison, current Fifth Avenue double-deck buses are 33 ft long, 13 ft high, and weigh 21,500 lb empty.) The gate house seats 90 people with standing room for 30. Its design contemplates the use of diesel power.

A double-deck vehicle is suggested because the height of the door on modern aircraft requires some means of getting the passenger from the ground to the aircraft. A second deck permits this with ease and helps fulfill the requirement of seating 90 passengers in one vehicle. Passengers enter and leave the vehicle from the second deck, which is adjustable to aircraft floor height through a large door in the left front. The door is remotely operated by the driver. Head room on both decks is 6 ft 3 in.

Driver Has Clear View

The driver sits on the right side, upper deck forward where he is in an excellent position to judge distances when maneuvering the vehicle up to the door of the aircraft or up to the loading dock on the upper level of the terminal building. His position on the right side permits the door to be on the left side of the center line of the vehicle, and allows the mobile gate house to approach the aircraft while maintaining a maximum clearance between the trailing edge of the wing and the left side of the vehicle. Since the passengers will be in the mobile gate house for as long as 20 minutes per round trip, air conditioning is included.

The vehicle is estimated to cost $45,000 in quantities of 100 with an operating cost of 21¢ a mile

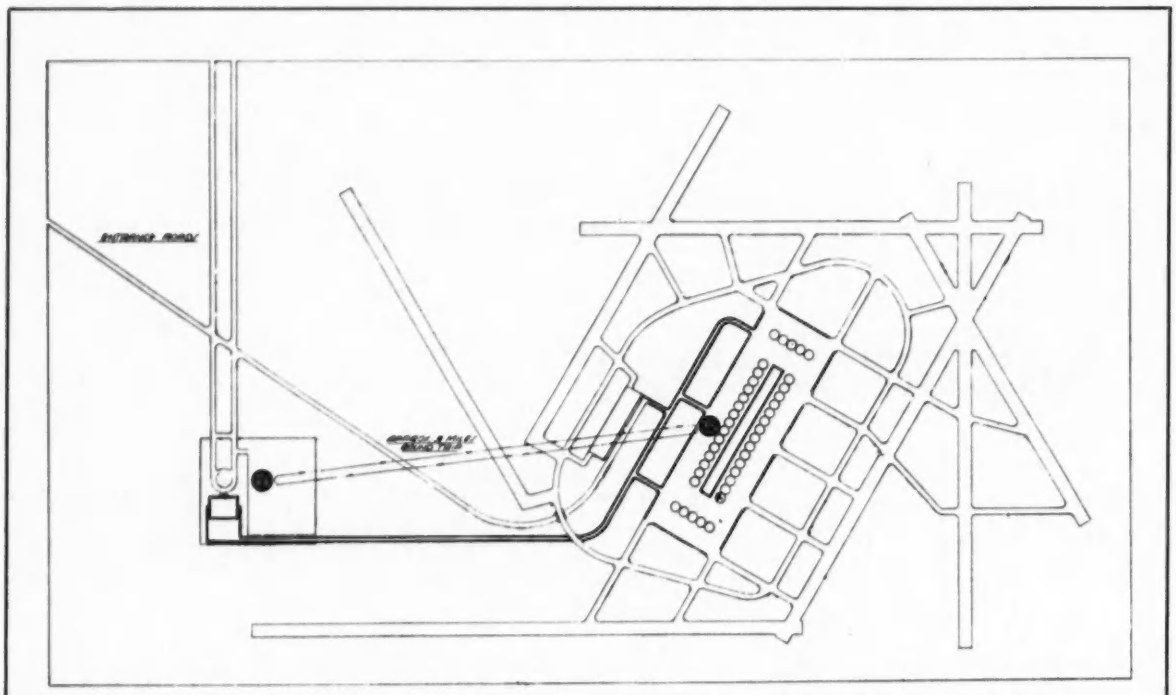


Fig. 2—Air terminal planned for use with mobile gate houses. Passenger building is at A. Servicing and maintenance facilities and passenger loading and unloading area are at B. Mobile gate houses carry passengers between A and B. Airport was designed to meet needs of a large Eastern city after 1965

exclusive of driver's salary. Its life expectancy is estimated at 15 years.

The airport shown in Fig. 2 was designed to meet the needs of a large Eastern city after 1965. To compare costs, an airport was designed along conventional lines to serve the same purposes. The 40-gate passenger building and the separate servicing apron for the conventional airport are shown in Fig. 3. The concrete apron required just to park aircraft came to 3,407,450 sq ft valued at $4,259,300. Maximum distance which a connecting passenger might have to walk between gates is 2000 ft. Average walking distance is 750 ft.

Mobile Gate House Saves Money

Table 1 compares the yearly operating cost of the items of expense which vary between the conventional passenger terminal and the mobile gate house passenger terminal. For the conventional design two items, namely the cost of the concrete apron and the cost of towing terminating and originating aircraft to and from the base facility area, are outstanding. Central terminal building, cargo building. base facility and baggage handling (other than baggage transportation) operating costs are considered identical in both plans.

For the mobile gate house passenger terminal, two costs are outstanding, mobile gate house operation and baggage transportation. No additional monies are included in the mobile gate house operation for the driver of the gate house, since the plan contemplates utilizing the second of the two agents who now check in aircraft passengers to operate the bus in his standby time and assist with the checking in of passengers during a 15-minute waiting period when the gate house is parked at the central terminal building.

The baggage transportation costs shown include the number of tractors and carts and the personnel required to transport baggage over the greater distances in the mobile gate house plan. They represent a substantial increase over the conventional plan.

Comparing the total yearly costs which vary between the two plans, we find that on an annual basis the conventional passenger terminal operating cost is $372,100 higher than that of the mobile gate house passenger terminal. This differential is in the duplication of the base facility concrete aprons and in the towing of terminating and originating aircraft between the base facility and the passenger terminal.

Noise is another reason for separating the passenger building from the parking areas. Experts tell us that even at idling speeds very large jet aircraft produce noise offensive to persons standing in the immediate vicinity. The decibel rating of the noise while high is secondary only to the high frequency—the principal offender. The experts further tell us that when starting large jet aircraft, as a precautionary measure against false starts,

the aircraft should be headed into the wind. Today's passenger terminal facilities will not protect the passenger and his friends from this noise, nor will they permit turning aircraft to insure starting while headed into the wind.

Possible Disadvantages

Of course, there are some aspects of the mobile gate house terminal plan which may be looked upon as disadvantages. For example, it will be necessary for passengers to arrive and board the mobile gate house about 15 minutes before departure of the aircraft. Normally passengers arrive this much earlier at the passenger terminal today. At tomorrow's large conventional passenger terminal, unless the mobile gate house is used, they will have to arrive even earlier in order to cover the longer walking distances to aircraft. However, there is no disputing the fact that the airline companies will take charge of passengers 10 minutes earlier and keep them 10 minutes later with the mobile gate house plan. This may be a psychological disadvantage to the plan.

Connections may require a 30 minute leeway instead of the present 20 minutes. There are those who think 20 minutes is impractical at the present time. This leeway will, no doubt, have to be increased at the larger conventional airports when longer walking times are required.

In order to enjoy the full financial advantage of the mobile gate house, it should be considered in the initial design of an airport. At passenger terminals where base facility and large aprons are already available, duplicating large passenger terminal aprons, moving the originating and terminating schedules to the base facility area for departure may or may not be desirable, depending upon the location of the facility with respect to the prevailing-wind runway. If the facility is remotely located from the prevailing-wind runway taxiing cost to the base facility may be higher than towing cost from the base facility to the terminal. In such a case, the mobile gate house may not offer a financial advantage.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price 25¢ to members, 50¢ to nonmembers.)

Table 1—Comparison of Estimated Yearly Operating Costs of Conventional Passenger Air Terminal and Mobile Gate House Passenger Air Terminal

	Conventional	Mobile Gate House
Central Terminal Building	—	No Change
Cargo Building	—	No Change
Base Facility Area	—	No Change
Baggage Handling	—	No Change
Baggage Transportation	$ 136,000	$199,800
Passenger Loading Fingers	$ 185,800	Not applicable
Concrete Apron	$ 299,000	$115,800
Aircraft Towing Cost	$ 437,460	Not applicable
Mobile Gate House	Not applicable	$349,900
Gate House Ramps and Roads	Not applicable	$ 14,100
Gate House Passenger Terminal Loading Docks	Not applicable	$ 2,490
Radio Dispatch Equipment	Not applicable	$ 4,070
Totals	$1,058,260	$686,160
	686,160	
Differential in Favor of the Mobile Gate House Airport	$ 372,100	

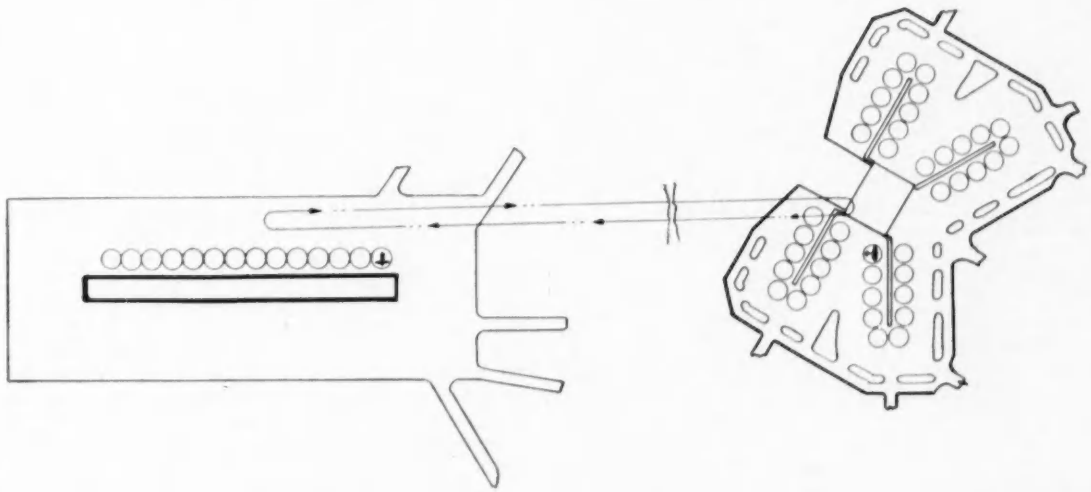


Fig. 3—Concrete aprons required for 40-gate airport designed along conventional lines for same purpose as airport shown in Fig. 2. Apron at left is for servicing and maintenance. Apron at right surrounds passenger building

Here's How to Graft

THE new Aldip process for coating steel parts with aluminum offers an opportunity to replace strategic, expensive materials needed for high-temperature oxidation and corrosion resistance. It doesn't have the shortcomings of other aluminum dip methods.

In many applications Aldip-coated steel has replaced stainless without any performance penalty. One such case is a military tank heat exchanger, formerly made of type 321 stainless. Aldip-coated assemblies have performed satisfactorily in service resisting corrosion from exhaust gas condensate.

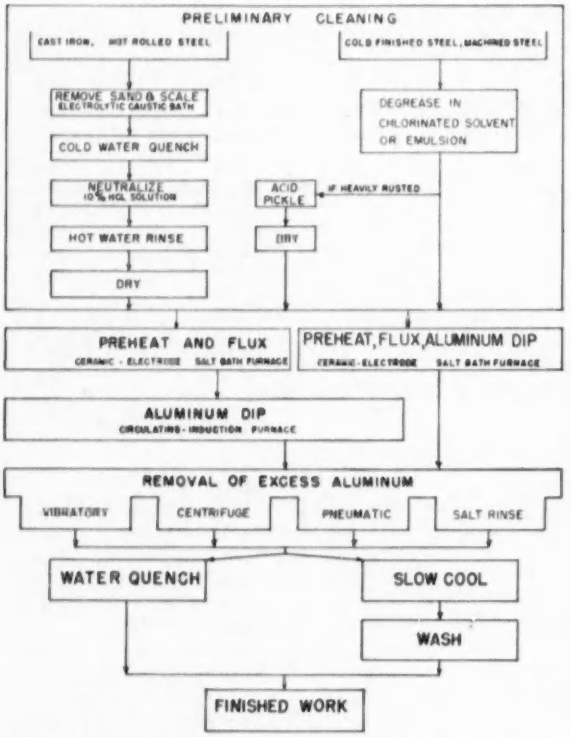


Fig. 1—The steps whereby steel parts and assemblies are aluminum-coated by the Aldip process

The switch has saved strategic chromium and nickel. Savings have accrued also from fabricating SAE 1010 steel instead of stainless.

In another case, Aldip-coated and diffusion heat-treated exhaust pipe adapters are used on trucks. The adapter is installed in the truck exhaust system in front of the muffler, where temperatures are high and exhaust gas condensate collects.

Diesel engine manifolds, made of SAE 1010, are replacing those of type 321 stainless. The saving per manifold amounts to 2.5 lb of nickel and 4.5 lb of chromium.

Other aluminum coating methods have been developed, but they all had disadvantages. In one process, aluminum was applied in a hydrogen atmosphere. This brought handling problems in draining off excess aluminum. In another process, the precoat metal contaminated the molten aluminum bath. The patented Aldip process has none of these shortcomings.

Aldip—How It's Done

The Aldip process can best be described by referring to the flow chart in Fig. 1. It outlines the various operations necessary to successfully clad steel parts or assemblies with aluminum.

Preliminary cleaning of the steel may be done by a number of alternate steps. The method chosen depends largely on type and surface cleanliness of the material to be processed.

Cast iron with typical carbon smear on the surface or hot-rolled steel with imbedded mill scale is cleaned in an electrolytic molten caustic salt at 900 F, following which it is neutralized in acid and washed in water. Welded structures with very thick oxide or entrapped welding-rod flux are cleaned the same way if the weld location is either inaccessible for sandblast treatment or such treatment is harmful to the part.

Other fabricated parts which are relatively clean can be degreased and aluminum-coated without preliminary treatment. Heavily rusted steel must be acid-pickled. Superficial rust formed before or after preliminary pickling will be dissolved in the preheating and fluxing bath.

Preheating and fluxing of the steel part is the next step. This is done in a molten salt bath maintained between 1300 and 1325 F. An electric furnace lined with special ceramic bricks contains this salt bath as well as molten aluminum at the bottom of the pot. Fig. 2 shows the salt-bath furnace in the immediate background. The stirring appara-

Aluminum Skin to Steel

D. K. Hanink and A. L. Boegehold
Research Laboratories Division, General Motors Corp.

Based on paper "Coating Steel by the Aldip Process" presented at SAE Annual Meeting, Detroit, Jan. 12, 1953. Complete paper will be printed in 1953 SAE Transactions.

tus mounted on the furnace structure maintains molten aluminum temperature by intermittently circulating hot salt at the metal and salt interface.

Preheated and fluxed parts can be *dipped* in either the molten aluminum beneath the salt bath or transferred to a low-frequency induction furnace containing molten aluminum. This furnace is shown in the foreground of Fig. 2.

When steel is fluxed and preheated to 1300 F in the special salt mixture, subsequent dipping in aluminum forms an instantaneous and continuous coating regardless of steel cross-sectional thickness.

Removal of excess aluminum coating on parts can be accomplished in a variety of ways. The preferred combination is a salt rinse in the preheat flux, followed by an air blast on spots where metal may accumulate.

Metallurgy of Aldip Coatings

Specifications designed to produce uniformity of a coated product require background data on both the surface alloy obtained beneath the aluminum overlay and its relationship with the alloy produced by subsequent heat-teratment. Therefore, data were obtained on:

- Thickness of the intermediate iron-aluminum compound with different dip times.
- Characteristics of the alloy layer produced by subsequent diffusion at different temperatures and times with respect to:

1. Approximate aluminum content.
2. Depth.
3. Resistance to oxidation.

The effect of aluminum dip time on thickness of the intermediate iron-aluminum compound for Aldip-coated SAE 1010 and 4130 steels is shown in Fig. 3. Typical microstructures that result when these steels are dipped for 15 sec and 2 min are shown in Figs. 4 to 7. (The longer dip time of 2 min is for parts which are to be conditioned for service by subsequent diffusion heat-treatment. The 15-sec dip is the usual treatment for parts that operate under service conditions which do not require heat-treatment.)

Why Diffusion Heat-Treatment

Tests under cyclic thermal shock conditions indicated the need for a diffusion heat-treatment that would eilminate spalling and cracking of the hard,

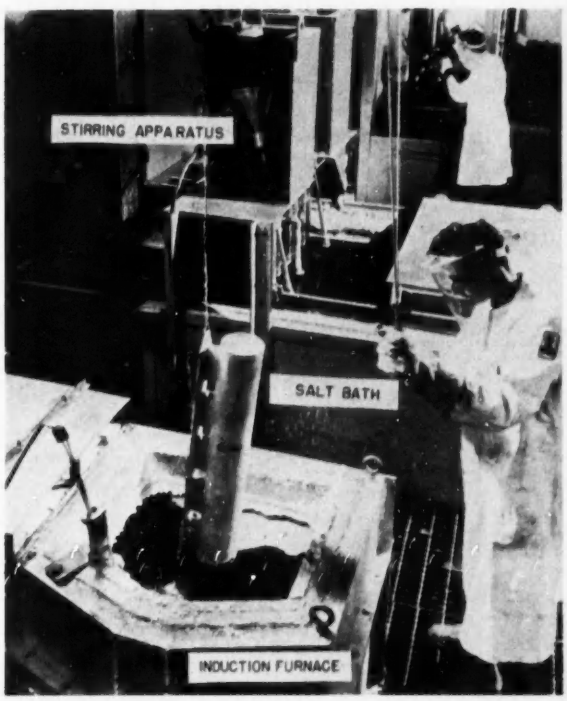
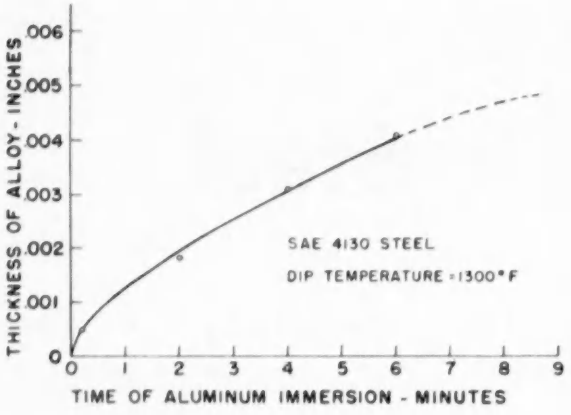


Fig. 2—A preheated and prefluxed steel part gets an aluminum coat in a low-frequency induction furnace. Since there is also molten aluminum beneath the salt bath, the part could have been dipped there if desired



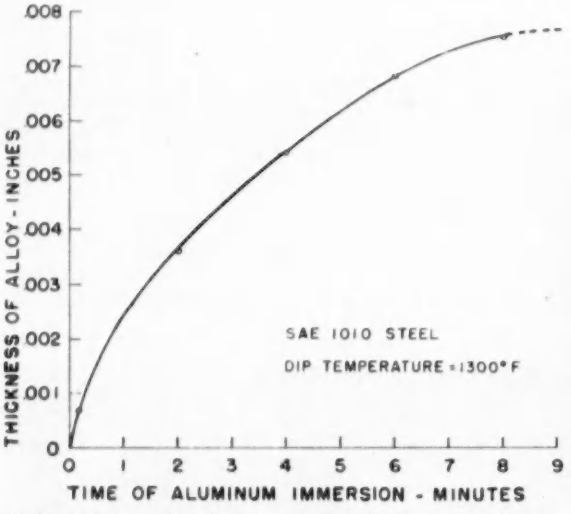


Fig. 3—This shows the effect of aluminum dip time on thickness of the intermediate iron-aluminum compound for two Aldip-coated SAE steels

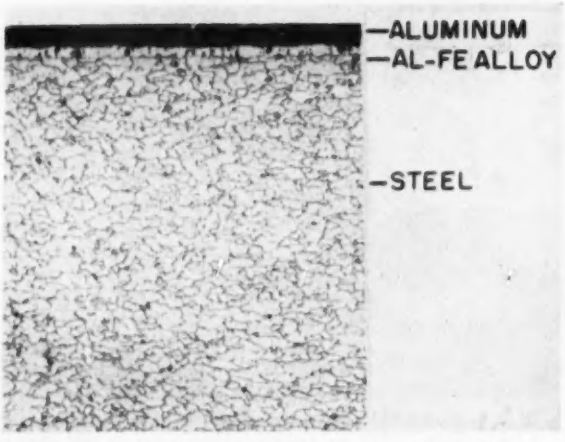


Fig. 4—Typical microstructure that results when SAE 1010 steel is dipped for 15 sec in aluminum bath. (Nital etch, 100x)

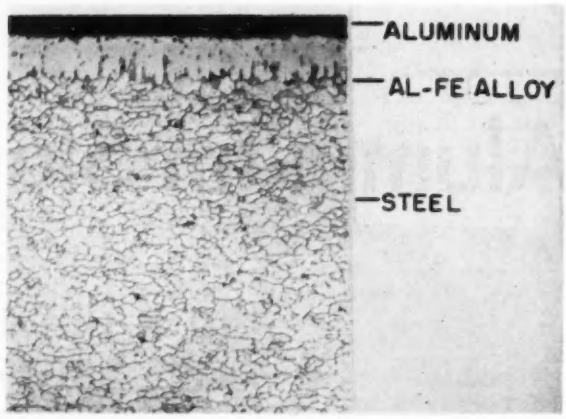


Fig. 5—Typical microstructure that results when SAE 1010 steel is dipped for 2 min in aluminum bath. (Nital etch, 100x)

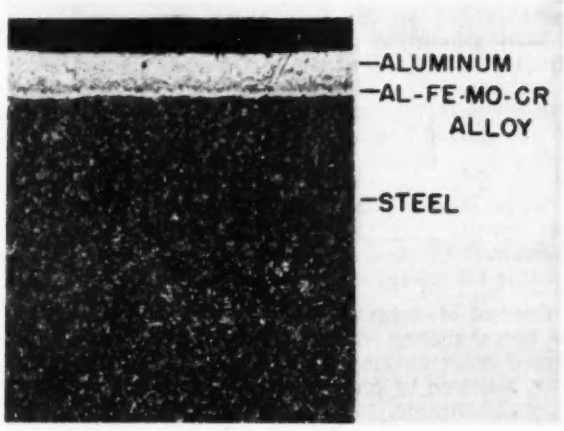


Fig 6—Typical microstructure that results when SAE 4130 steel is dipped for 15 sec in aluminum bath. (Nital etch, 100x)

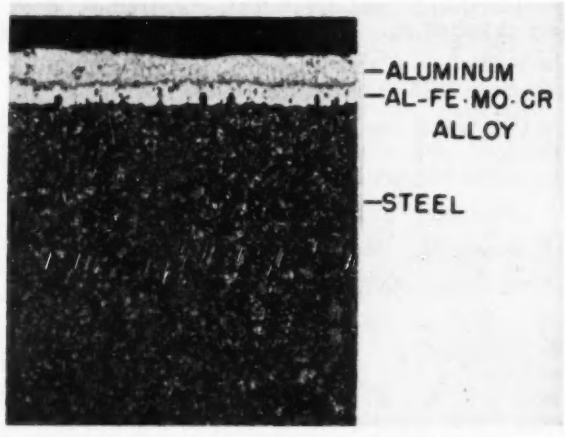


Fig. 7—Typical microstructure that results when SAE 4130 steel is dipped for 2 min in aluminum bath. (Nital etch, 100x)

brittle, surface alloy protective layer. Thus the three variables of dip time, diffusion time, and diffusion temperature were investigated to determine their individual and combined influence on the iron-aluminum alloy layer.

SAE 1010 steel samples were given a 2-min and 8-min dip in aluminum, followed by heat-treatment at various tempertaures for 1 and 4 hr. Data obtained are shown in Fig. 8. They show the rate of alpha or solid-solution phase formation as a result of aluminum diffusion into steel at different temperatures.

The important observations relative to this family of curves are (1) rate of diffusion is increased substantially when the base steel is austenitic above the Ac_3, 1650 F, and (2) diffusion rate is not affected by aluminum dip time as long as there is excess iron-aluminum alloy available.

Early experience in field operation showed that spalling depends upon aluminum content and distribution in the alloy layer. The higher the aluminum content the greater the tendency for spalling. By the same token, the higher the aluminum content the greater the oxidation resistance. To permit arriving at best compromises later on, a study was made of the relationship between heat-treat diffusion and final aluminum content of the surface alloy with respect to spalling susceptibility and oxidation resistance.

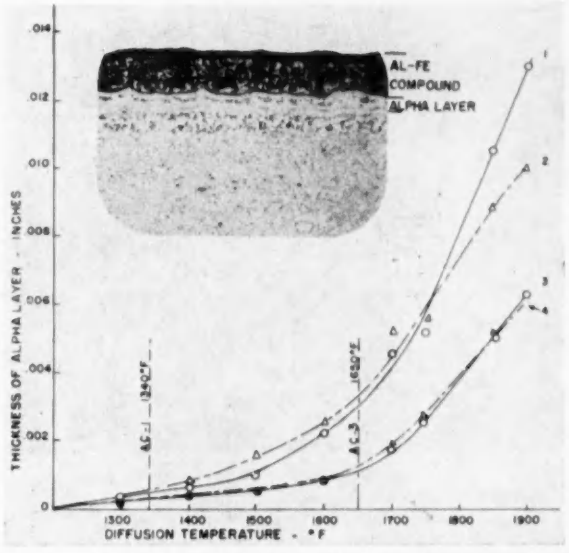


Fig. 8—Rate of alpha or solid-solution phase formation as a result of aluminum diffusion into SAE 1010 steel at different diffusion temperatures. Curves 1 and 2 are for dip times of 8 min and 2 min, respectively, and a diffusion time of 4 hr. Curves 3 and 4 are for 2-min and 8-min dip times, respectively, with a diffusion time of 1 hr

Aluminum Content in Diffused Alloy Layer

First, hardness of low carbon steels was correlated with various amounts of aluminum contained in them. (See Fig. 9.) This relationship provided a method for rapidly determining approximate aluminum content across iron-aluminum diffused alloy layers. It was just a matter of completing microhardness surveys, then comparing hardness with the per cent by weight aluminum shown in the curves.

In this way, aluminum concentration gradients were determined for a number of different aluminum dip and heat-treat conditions. They showed that a longer diffusion time is necessary to produce equivalent aluminum concentration gradients when dip time is increased.

This effect of dip time on aluminum content at different depths in diffused iron-aluminum alloy layers is apparent in the photomicrographs, Figs. 10 and 11. The microstructure representing the short 2-min dip (followed by diffusion for 1 hr at 1800 F) shows a relatively uniform phase throughout the aluminum-rich alloy layer. The 6-min dip, however, resulted in formation of an alloy layer with high concentration iron-aluminum compounds at the surface and a mixture of solid-solution and compound phases near the base steel. In short, the aluminum available for diffusion after a 6-min dip is too great for the 1 hr diffusion time. Experience has shown that a steel part so treated is subject to spalling under thermal shock at elevated temperatures.

For any specified aluminum dip, therefore, the diffusion heat-treatment should also be specified since both variables will determine the final amount

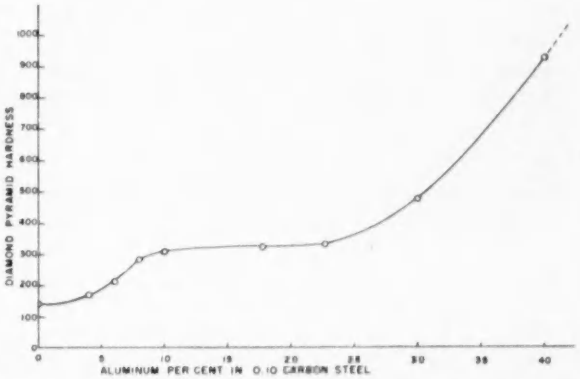


Fig. 9—This correlation of hardness of low carbon steels with aluminum content made it possible to determine approximate aluminum content of diffused iron-aluminum alloy layers merely by making microhardness surveys

and distribution of the aluminum in the surface alloy layer.

Case Depth

Whether desired performance will be achieved with an aluminum-dipped and diffused steel part depends on case depth of the part. (Case depth refers to the surface alloy layer containing iron-aluminum and is measured from the surface to the unaffected steel core.) Figs. 12 to 15 show the range of heat-treatments that will give satisfactory case depths in 15-sec, 2-min, 4-min, and 6-min dipped SAE 1010 steel parts. The zones as outlined

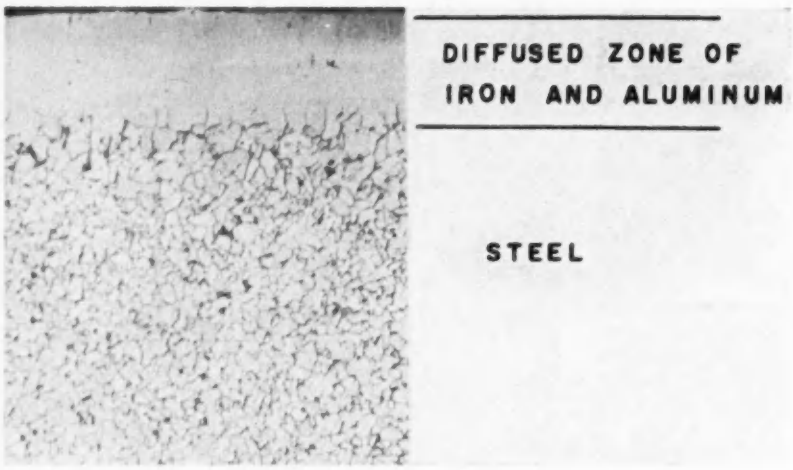


Fig. 10—This shows what happened when an SAE 1010 steel sample was given a 2-min dip and a 1 hr diffusion heat-treatment at 1800 F. Note the relatively uniform phase throughout the aluminum-rich alloy layer. (Nital etch, 100x)

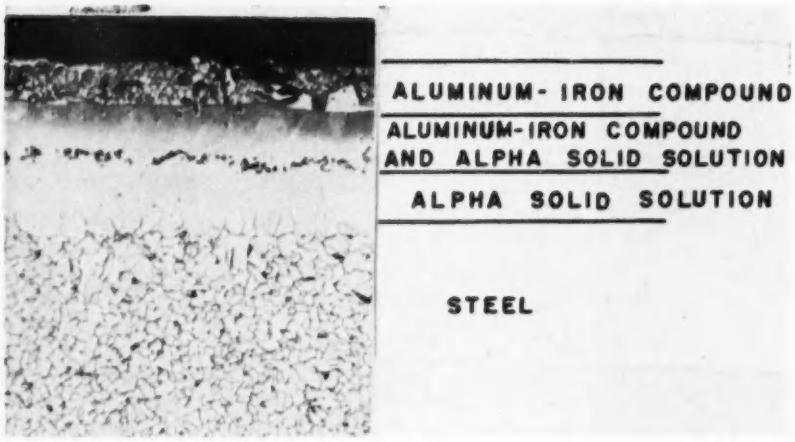


Fig. 11—Microstructure of an SAE 1010 steel sample that was given a 6-min dip and a 1 hr diffusion heat-treatment at 1800 F. In this case there was not enough time for the aluminum to be become completely diffused throughout the iron-alumnium alloy layer

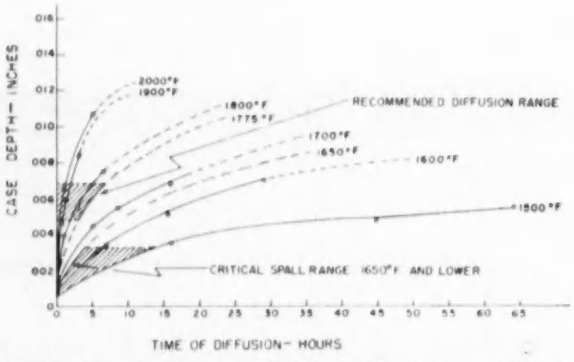


Fig. 12—This shows the range of diffusion heat-treatments that will give satisfactory case depths with 15-sec aluminum-dipped SAE 1010 steel samples

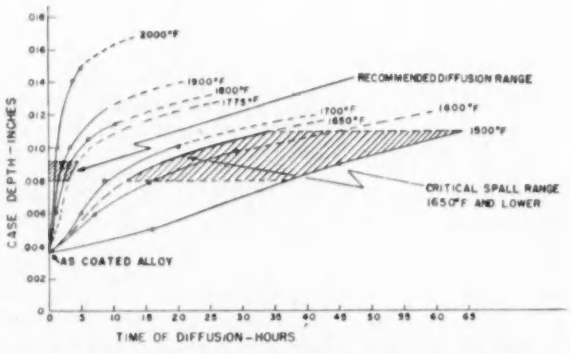


Fig. 13—This shows the range of diffusion heat-treatments that will give satisfactory case depths with 2-min aluminum-dipped SAE 1010 steel samples

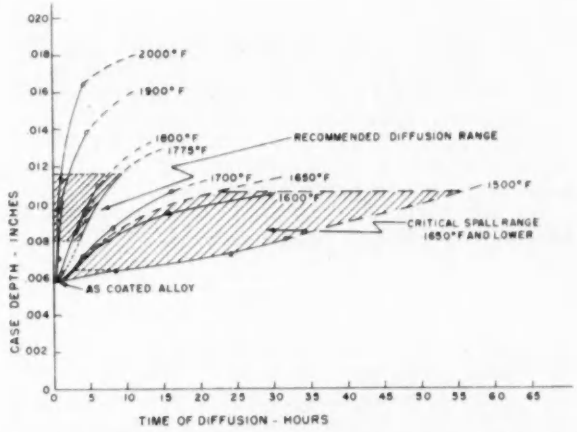


Fig. 14—This shows the range of diffusion heat-treatments that will give satisfactory case depths with 4-min aluminum-dipped SAE 1010 steel samples

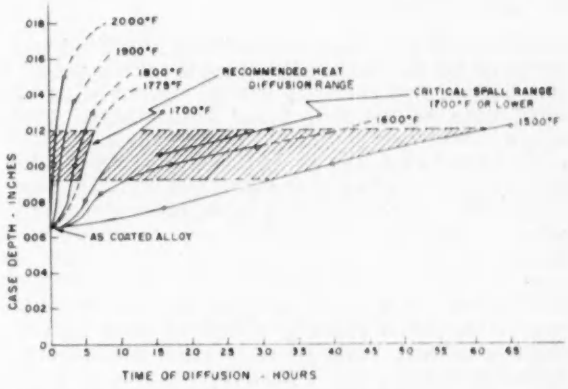


Fig. 15—This shows the range of diffusion heat-treatments that will give satisfactory case depths with 6-min aluminum-dipped SAE 1010 steel samples

on the curves represent both production experience and laboratory tests on steel panels. The minimum case depths obtained at the minimum diffusion temperature of 1775 F will possess the required aluminum level for resistance to thermal shock heating and cooling. The maximum case depths shown on the curves will also insure sufficient aluminum concentration in the surface alloy for best heat resistance.

Oxidation Resistance

Resistance of aluminum-coated steel to oxide penetration at elevated temperatures is fundamentally due to the formation of aluminum oxides and complex iron-aluminum oxides which provide a protective, adherent refractory scale. As oxygen slowly penetrates the scale to form additional oxides, resistance to further penetration increases. At the maximum temperature of recommended operation (1600 F), however, a finite life of a part may be reached after a long period of time. This happens when oxides form in the lower aluminum content subsurface strata. The scale thus formed is primarily iron oxide which offers less protection. Scale adherence also is poor. Aluminum concentrations of less than 10% by weight in the alloy layer are too low for adequate protection from oxide penetration at temperatures of 1600 F or higher.

The bar chart in Fig. 16 compares the average oxidation life of 0.036 in. thick SAE 1010 steel panels given 15-sec, 2-min, 4-min, and 6-min dips. The tests were conducted at 1650 F in air atmosphere on steel which had been diffusion heat-treated for best aluminum concentration in the case. All test panels were aircooled after each 20 hr period at 1650 F. They were then weighed to determine weight gained from oxygen adsorption. It is concluded from these tests that 1600 F should be the upper limit of service temperature when extremely long life is required.

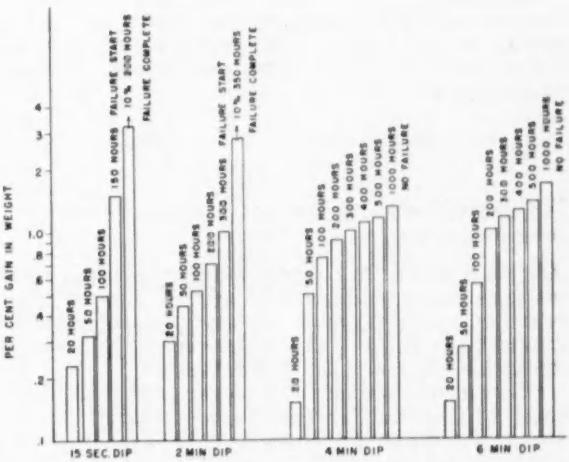


Fig. 16—Comparison of weight pickup or average oxidation life of SAE 1010 steel panels given four different aluminum dips

This maximum service temperature could be raised if it were practical to aluminum dip for longer than 6 min. In production, however, long dip times are not specified because of iron solution in the dip metal, which if contaminated beyond 4% iron becomes less fluid. This creates problems in operation of the equipment.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Turn page for **DISCUSSION**

Here's what discussers said about Aldip . . .

M. G. Whitfield
Whitfield & Sheshunoff, Inc.

ALUMINUM-DIP coating has been practiced successfully for a number of years without the use of a flux bath or flux coating. A wide variety of objects have been coated and found satisfactory. They range from straight tubes, bars, and sheets to more complicated cast-iron shapes, such as stove grates, burner pipes, muffler assemblies, and so forth.

In our work on spalling of aluminum coatings when exposed to intermittent service at elevated temperatures, we have developed a type of alloy surface layer that is exceptionally free of spalling difficulties. The typically hard alloy coating also may be useful for applications where a surface containing minute porosity has merit, for example, cylinder walls.

Considerable work has been done with regard to the question of dipping time versus iron buildup in the molten aluminum-coating bath. Among other methods, adding alloys to the coating bath is successful in some instances. One of the processes we are using experimentally holds promise of eliminating this problem.

Any practical method of controlling solution of the base metal also assures longer life at a given service temperature. This should open up additional fields of use for aluminum-coated products of all types.

K. Oganowski and T. F. Olt
Armco Steel Corp.

AS producers of flat-rolled aluminum-coated steel, we have long recognized not only the unique properties of such a product, but also the large field of applications for it. The Aldip process appears to fulfill the requirements of this field.

The authors do not refer to the influence of the unalloyed coating surface layer obtained intially during the dipping operation. This layer undoubtedly participates in the diffusion stage. Would finishing methods employed in the Aldip process be amenable to regulating the thickness of the free aluminum layer, thus allowing increased thickness of the diffused coating without need for extending dipping time beyond the critical 6 min?

The authors point out that the diffused coating offers satisfactory protection from scaling for long life requirements up to 1600 F. In most applications at these temperatures, mild steel as a base metal would not be satisfactory due to lack of strength. Alloyed steels would have to be used as a base. What types of low-alloy steels other than 4130 can be successfully coated by the Aldip process?

Closure

IN the Aldip process we attempt to control thickness of the intermediate iron-aluminum layer, particularly on parts which are subsequently diffusion heat-treated, because we feel this is a controlled source of aluminum for diffusion. If we depended on the aluminum overlay, we could not obtain uniformity of the resulting diffused alloy because of run-down while heating the part up to the diffusion temperature. Although the aluminum overlay participates in a minor way to some alloy formation, the majority of it is oxidized during the diffusion treatment in the air atmosphere that is used.

We can aluminum-coat any steel regardless of alloy content as long as iron is the base metal.

Question: In the Aldip process do you get full coverage without pin holes? If there are such discontinuities, is the pitting severe or does lateral diffusion prevent this?

Answer: We experienced some difficulty with coating discontinuities in early investigations. Lateral diffusion does afford some protection. In present refined practice, however, a continuous surface coating is obtained.

Question: How high have you been able to go in alloy content in steel containing chromium and nickel? What balance have you found that you cannot go beyond?

Answer: Type 310 stainless steel is the present experience. It coated satisfactorily.

Question: What happens to a surface where a little air or salt is trapped? How often does this occur?

Answer: We examine the geometry of each part before proceeding to coat. We generally do not work with parts that are designed so that we cannot get the salt in contact with surfaces which are to be coated. A vibratory motion in the salt bath can be used to eliminate air traps. When we process parts, suitable procedures are used to guarantee absence of air traps.

Question: Can aluminum be brazed to aluminum-coated parts? Have you coated meat-handling hooks and such equipment?

Answer: In brazing, aluminum-coated material is treated as if it were made of aluminum. Specific items you mentioned have not been aluminum-coated.

Question: Have you been successful in controlling iron content of the bath by the control cooling method?

Answer: We control aluminum dipping time so that aluminum drag-out is sufficiently high so that when fresh aluminum is added, iron content remains about the same—2½ to 3%.

Question: Equipment as described is expensive. What part of the cost of this process may be attributed to the use of flux? Is it suitable for a small operator?

Answer: The small operator who may be interested in the Aldip process must face high initial investment costs. Beyond that we have a relatively inexpensive process because flux will not cost appreciably more than average heat-treating salts.

Flight Tests

Are Vital to Jet Installation Development

J. R. Steding, Allison Division, General Motors Corp.

Excerpts from paper "Flight Testing of Prototype Engines as Primary Powerplants in New Airplanes" was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 4, 1952.

MATING a jet engine to a new airplane requires extensive flight testing of the engine in the airplane. This is true even for engines which have piled up data in previous production aircraft or in flying test beds.

Engines and afterburners installed in different aircraft respond differently. Only when engine and afterburner performance in a particular installation is determined can controls be scheduled finally for that airplane. Almost always in the course of these determinations, unforeseen difficulties show up, requiring additional investigations. These may entail vibration studies, temperature surveys, or special system-pressure surveys.

The first few flights are of the nature of shakedowns, or flights establishing baselines for projected test planning. In this phase general performance in terms of maximum altitude, high-speed operation, thrust output (if only in terms of rate of climb), vibration, cooling ejector performance, and starting is recorded. In addition, the control unit is checked for maximum and idle speed control at variable air densities for changes in altitude as well as speed. Abrupt throttle movements are performed at a critical range of altitudes and airspeeds to check for compressor surge, overspeed, excessive turbine temperature, or flameout. The stand-by emergency control is investigated in its range of operation. The afterburner is tested for maximum altitude, turbine temperature control, aircraft velocities wherein the afterburner is usable, and starting. During these exploratory tests any unusual phenomena are noted for further detailed investigation.

First element studied intensively is the inlet duct. Modifications are made and flown until flight tests show which configuration constitutes the best compromise. Then these other problems are tackled:

Cooling

Temperature surveys of the engine-mounted components as well as nacelle structures are always required because of temperature limitation on material and parts, particularly on buried installations where primary structure is affected. Maximum temperatures sometimes occur at high altitude, although this problem is usually associated with static ground operation where relatively little ram cooling air and high ambient conditions are encountered. Ejector parameters have to be held within proper limits even though there may be a variable nozzle. A good deal of trial and error is sometimes involved in such an ejector design problem. As a result of one experience, considerable thrust improvement was noted on refinement of the ejector parameters for reduced pumping. On the other hand, one case required an improvement of cooling airflow quantities to provide adequate cooling air for the aft nacelle to avoid severe overheating.

Jet Nozzle and Duct

Unless an engine is provided with a variable or adjustable nozzle the engine tailpipe furnished with the aircraft for the engine must be checked for proper performance. The depressing effect of the inlet duct conditions on the engine usually requires modification of the jet nozzle to ensure guaranteed performance or protect against prohibitive engine operating temperatures. Nozzle size must be verified or determined before further tests can be continued. Practical production limits for such items must be considered and evaluated. Until the nozzle size and duct configuration are fixed in final form, the engine control cannot be scheduled.

Engine Controls

The control must be adjusted to maintain a constant engine speed at varying air density, either in terms of fuel rate changes or nozzle control. It must maintain a satisfactory idle speed at all conditions to avoid engine flameout. During throttle burst accelerations, the fuel metering unit must function to avoid the compressor surge range to keep turbine gas temperatures within limits, and to avoid overspeed—and at the same time it must provide a satisfactorily fast change from idle to

full throttle. It must meter fuel during snap decelerations so as to avoid engine flameout. It must maintain engine speed stability at any fixed throttle position. Its operation must even be unaffected by g loading. In addition there may be secondary or emergency controls requiring a different set of limitations. Also some parallelism must exist between the main and emergency systems so that they can be switched back and forth for checking out. The requirements are met only through extensive flight test work and evaluation.

It has never been known positively from stand operation alone whether a given engine will at some altitude and airspeed combination encounter the surge range of the compressor during a throttle burst. An engine in one type of aircraft might never encounter this condition in operational use, whereas in another type of aircraft the same engine will be plagued with this problem. For example, a fighter refueling in flight at medium altitudes and low airspeed is required to be jockeyed constantly for position. If abrupt throttle movements required for this operation result in compressor surge, the manipulation of the airplane in close quarters becomes impossible.

Because it is not always known for what types of aircraft the engine will meet this condition, Allison recognizes the importance of putting only stall-free engines into service. For a prototype engine inadvertant operation in the surge range of the compressor is corrected by changes in control scheduling. Because duct configuration affects the control sensing and also modifies the surge range, the final determination that compressor surge will not be encountered can only be made after the engine is in the particular airplane. Throttle bursts at various altitude and airspeed combinations will show up whatever surge conditions there are. Recorded data will indicate the correction needed in the basic control schedule.

Afterburner Controls

Afterburners give markedly different results with different engines and different installations. Afterburning is sensitive to changes in duct recovery, inlet velocity, flow rate, and jet nozzle size. Performance is determined in flight tests, then controls adjusted accordingly and checked in further flight tests.

For some afterburners pilot technique is important. Flame stability in a large pipe is sensitive to ram pressure ratio as well as sudden changes in tailpipe pressure. Abrupt flight maneuvers at high altitude can cause unexpected afterburner flameout. As a result it may be necessary to develop a relight technique for a given airplane at altitudes close to maximum operating altitude.

During the development of the afterburning unit for its maximum altitude performance, thrust is an item that cannot be forgotten. The thrust gain of the afterburner must be maintained at a high level. A change in configuration or in procedure that increases maximum burning altitude might severely reduce thrust output at lower altitudes. Because this usually cannot be tolerated, every change affecting maximum altitude must be checked at all altitudes for its influence on thrust performance. Because tailpipe temperature measurements are difficult to make at afterburning temperatures, thrust output can only be measured on a comparative basis. The most obvious indication of afterburner thrust output is airplane rate of climb. For each afterburner change a record of the resulting effect on climb performance is a relative indication of effect on thrust output.

Miscellaneous Problems

An engine installed in a particular airplane sometimes develops an adverse vibration not experienced on the test stand or in any other type of installation. Its resonant source must be located and corrected. Another engine in another aircraft may suffer occasional compressor inducer failure as the result of adverse air loading due to the duct stratification. Either a duct modification or engine part change or both must be accomplished.

Equipment added to the engine by the aircraft manufacturer sometimes complicates operations of a related part. For example, a generator furnished by the aircraft manufacturer added to an extension shaft from the accessory case, cooled with ram air, upset the seal differential pressures in one installation enough to cause an extensive investigation and modification to the engine pressure balance system. Such problems are impossible to predict.

(Paper on which this abridgment is based is available in multilithographed form from SAE Special Publications Department. Price 25¢ to members, 50¢ to nonmembers.)

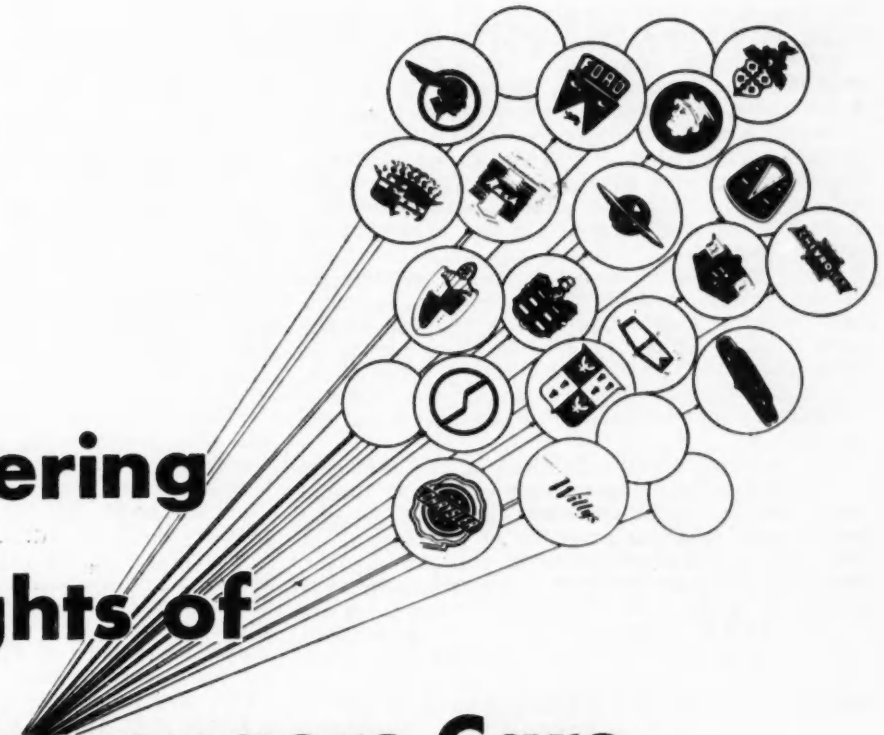
Excerpts from discussion by

R. R. Templeton, North American Aviation, Inc.

Steding has pointed to the intimate effect of engine air inlet duct configuration upon engine controls which primarily sense engine inlet conditions. It is urged that controls be designed away from such a primary sensing system in so far as possible by use of pressure levels farther downstream in the engine, and by the use of topping limits wherever practical. It should thus be possible to reduce control sensitivity to inlet ducting to a minimum.

Steding's remarks on the necessity of trial and error development of a satisfactory cooling jet ejector emphasize the need for development by both engine and airframe companies of complete and detailed ejector design criteria. There is great need for such an industry-wide and country-wide project, that we may eventually eliminate the waste resulting from duplication of effort now taking place at many points in an attempt to establish the optimum ejector design for each application.

A caution should be expressed regarding consideration of the afterburner and its control system as a problem apart from the main engine. North American Aviation, Inc. has found that the completely successful functional integration of afterburner and main engine requires a delicacy of control and timing which is somewhat beyond the capabilities of any system yet developed. Recent substantial extension of operating altitudes for afterburner-equipped jet engines has only intensified the need for control systems capable of developing maximum performance.



Engineering Highlights of 1953 Passengers Cars

W. S. James, Vice-President of Research and Engineering, Fram Corp.

Excerpts from paper "Engineering Highlights of 1953 Passenger Cars," presented at SAE National Passenger Car, Body, and Materials Meeting, Detroit, March 4, 1953.

THE most important engineering developments in passenger cars in 1953 indicate that the car manufacturers are more in a race to give greater human comfort for their customers than for greater horsepower.

Trends in design in 1952 and 1953 passenger cars indicate that:

- IN ENGINES: V-8 designs are becoming increasingly popular. Compression ratios are still going up. Volumetric efficiency for "breathing capacity" is increasing. Engine rpm at 45 mph is decreasing.
- IN TRANSMISSIONS AND AXLES: Torque converters are gaining in popularity over fluid couplings. Axle ratios used with automatic transmissions are more nearly like those used with conventional transmissions. Axle ratios used with overdrive transmissions are about 10% higher than those used with conventional transmissions.
- IN ELECTRICAL EQUIPMENT: In some cases voltage doubled (6 to 12 V) and maximum generator output increased about 30%.
- IN STEERING: Turning diameters are increasing. With power steering, over-all steering ratios are unchanged in some cases and reduced 40% in others.
- IN SUSPENSION: Tendency is toward lower spring rates at wheel.
- IN BODIES: Almost half of 1953 cars have completely new bodies. Long, smooth, flowing lines predominate. In many cases, the fenders are absorbed into the main body lines. In some designs, although the front fenders are completely absorbed into the main body lines, a suggestion of the rear fenders remain. All doors are hinged at the front. One-piece windshields and three-piece rear windows are increasing. External hood locks are replacing internal locks. Enamel seems to be replacing lacquer. Shoulder room is decreasing in both front and rear seats. Hip room is decreasing in front seats, but not in rear seats. Road clearance is decreasing.

An examination of the "special" units available in many cars shows that they are what might be

called comfort items and are of particular interest to the woman driver.

Power brakes, power steering, and automatic transmissions make traffic driving and parking much easier. All reduce the physical effort required to handle a car. Automatic headlight dimmers and signal-seeking radios permit the driver to devote his attention more completely to driving and relieve mental strain. Air conditioning and tinted glass improve the physical comfort of the driver and passengers.

"Hard-top" bodies have most of the advantages of convertibles without the disadvantages. The large glass area gives the feeling of being in the open without being "wind-blown" and having to worry about the top working in inclement weather. The appearance of the hard top has the "eye appeal" of the convertible without the short life of the canvas top.

The most significant highlight of the 1953 cars is the tremendous number and variety of special equipment, or accessory items, and even special sports cars, that are available to purchasers. It will probably be very difficult to purchase a plain, ordinary car. In addition to special sport car models with special high output engines, there are at least nine major special equipment items available on many cars. In some cases, the cost of the special equipment items, and accessories can amount to over 25% of the cost of the basic car.

New Development Technique

These accessories and items of special equipment have a real value other than providing the car dealers with an additional source of revenue and a help in trade-in negotiations. They are, in one sense, trial balloons, or market development tools. They provide the means for accelerating the development and reducing the production cost of items usually available only in high-priced cars.

As special equipment, they can become available on the lowest priced cars in a shorter period of time and in a more advanced stage of development. At the same time, there is a much reduced hazard to the main line of products. In fact, an examination of the items of special equipment reveal the real engineering highlights of 1953.

Power steering is an excellent example of these highlights. Although it has only been used about one year, it is now being made by four parts manufacturers. In three of these designs, hydraulic power is used and in the fourth mechanical boost obtained directly from the engine. In two of the hydraulic designs, the hydraulic power cylinder is built into the steering gear housing, while the third applies the hydraulic power boost tc the steering linkage.

Field and manufacturing experience probably will refine and simplify these designs within a few more years. This valuable experience will reduce the time before power steering of one kind, or another will be standard equipment on most cars and possibly available on all.

A similar development, now in a more advanced stage, is taking place in automatic transmissions. Turn signals are an example of an item in which the development cycle is almost complete, and if public acceptance is obtained, the availability of air-conditioning, power brakes, tinted glass, and so forth, may follow the same pattern.

Sports cars, even at exorbitant prices, can prove of great value in the germination of ideas, which otherwise might lie dormant indefinitely. If some of these possibly radical ideas do not quite come up to expectation, the hazard of prestige lost to the basic product is not serious.

What follows is a kind of statistical examination of the design details of the 1953 cars, as compared with those of 1952 cars. In this analysis many of the items in the AMA Standardized Specifications have been used.

Significant Developments Surveyed . . .

The engineering highlights of the passenger cars designed by American engineers for 1953 production are quite varied and numerous. In describing them, it is difficult to avoid a simple listing. It would be an impressive list and valuable as a record; but for those who conceived and brought these ideas into being, it might be very boring to read, or listen to.

In a summary of this kind it is also difficult to go into detail on particular developments. The technical description of important specific developments is better covered in special papers and by authors with first-hand, intimate knowledge of them.

Therefore, in this article an effort will be made to present a general survey of what appear to be the most significant engineering developments. Then a number of the elements of the passenger car will be examined for what appear to be design trends, either established, or developing, as revealed by a sort of statistical examination of the specifications for 1952 and 1953 passenger cars, as listed in the Automobile Manufacturers Association Consolidated Specification Questionnaire . . . which specifications were tabulated from the 1952 and 1953 Statistical Issues of "Automotive Industries."

The author's thanks also go to the many passenger car engineers throughout the industry who contributed information and assistance.

In presuming to discuss the highlights of the 1953 models, the author realizes fully the differences of opinion which may make his discussion seem out of focus. But such differences are natural and unavoidable, possibly at times valuable.

Outside Dimensions of Cars

Overall Length

The first comparison given is that of the outside dimensions of cars. In this comparison the overall lengths, widths, and heights of the 1952 and 1953 cars were divided into a number of arbitrary groups. In one group, for example, were included those cars having lengths between 170 and 180 in., in another, those 180 and 190 in., in a third those between 190 and 200 in., and so on. The number of cars in each length group was counted and the concentration of 1953 cars in the given group compared with the concentration of 1952 cars in the same group.

In the case of the overall length of cars, an examination of the table shows that 77% of 1952 cars and 73% of 1953 cars were between 190 and 220 in. overall length. This is very little difference, but the fact that there are twice as many cars in the 210–220-in. group in 1953 as in the 190–200-in. group shows a slight trend toward longer cars.

Length	1952		1953	
170–180	1		–	
180–190	2		5	
190–200	5		5	
200–210	13	77%	12	73%
210–220	5		10	
220–230	2		3	
230–240	2		1	
240–250	–		1	
Total	30		37	

Overall Width

In the case of overall width, the groups between 73 and 78 in. wide show a reduction in the number of cars in 1953 and an increased tendency toward the narrow cars from 69 to 72 in. wide. There is, therefore, an indication of slightly narrower cars in 1953.

Width	1952		1953	
69–70	2		3	
71–72	2		3	
73–74	7		5	
75–76	6	71%	5	61%
77–78	7		6	
79–80	4		3	
81–82	–		1	
	28		26	

Overall Height

In the case of overall height there is a rather clear indication of a reduction in height, 87% of the cars between 60 and 63 in. in 1953, and only 64% in 1952. On the whole, therefore, 1953 cars are lower, somewhat narrower, and possibly a little longer than in 1952.

Height	1952		1953	
56–57	1		1	
58–59	1		2	
60–61	7	64%	12	87%
62–63	13		22	
64–65	9		1	
66–67	–		–	
68–69	–		1	
	31		39	

Wheelbase

The wheelbase of 1952 and 1953 cars was almost the same, and no change indicated.

Wheelbase, in.	1952		1953	
100–105	1		1	
105–110	1		1	
110–115	3		3	
115–120	7		7	
120–125	8	69%	9	68%
125–130	5		5	
130–135	2		2	
135–140	–		–	
140–145	–		–	
145–150	2		3	
Total	29		31	

Tread

In 1953 the front-wheel tread increased slightly, but the rear-wheel tread remained almost unchanged.

Tread, in.	Front				Rear			
	1952		1953		1952		1953	
53–54	2		1		4		1	
55–56	13	72%	10	57%	5		6	
57–58	12		10		6	54%	7	54%
59–60	8		14		13		12	
61–62					3		5	
63–64					3		3	
65–66					1		1	
Total	35		35		35		35	

Body Dimensions (Interior)

Shoulder Room – Front Seat

There is a reduction in width of shoulder room in the front seat of 1953 cars.

Width, in.	1952	1953
52 and 53	–	2
54 and 55	6	10
56 and 57	15–43%	22–52%
58 and 59	8	3
60 and 61	4	2
62 and 63	2	3
Total	35	42

Shoulder Room – Rear Seat

The 1953 cars have slightly less shoulder width in the rear seat.

Width, in.	1952	1953
47 and 48	2	2
49 and 50	–	–
51 and 52	3	3
53 and 54	4	10
55 and 56	18–53%	16–38%
57 and 58	5	9
59 and 60	–	–
61 and 62	2	2
Total	34	42

Front Seat Height Above Floor

Distance from the floor to the top of the front seat is somewhat less in 1953 cars.

Height, in.	1952	1953
10–11	–	2
11–12	3	3
12–13	5	7
13–14	9 } 54%	14 } 74%
14–15	10 }	21 }
15–16	8	–
Total	35	47

Rear Seat Height Above Floor

There is very little difference between 1953 and 1952 cars in the distance from the floor to the top of the rear seat.

Height, in.	1952	1953
11–12	1	4
12–13	16 } 69%	20 } 63%
13–14	9 }	8 }
14–15	1	10
15–16	8	2
16–17	1	–
Total	36	44

Hip Room – Front Seat

Hip room in 1953 cars is slightly less than that in 1952 ones.

Width, in.	1952	1953
57 and 58	–	5
59 and 60	7	10
61 and 62	13 } 74%	13 } 60%
63 and 64	12 }	13 }
65 and 66	2	2
Total	34	43

Hip Room – Rear Seat

There appears to be little change in the rear-seat hip room of 1953 cars. If anything, it is somewhat wider.

Width, in.	1952	1953
49 and 50	1	–
51 and 52	3	4
53 and 54	4	1
55 and 56	2	3
57 and 58	3	5
59 and 60	4	9
61 and 62	5 } 61%	7 } 69%
63 and 64	11 }	13 }
Total	33	42

Ground Clearances

Minimum Road Clearance

The minimum ground clearance for 1953 and 1952 cars is very much alike.

Clearance, in.	1952	1953
5–6	–	1
6–7	11	11
7–8	15–50%	27–68%
8–9	4	1
Total	30	40

Angle of Departure

The angle of departure in 1953 cars is lower than that in 1952 cars. This increases the tendency of the rear bumper to strike the pavement when coming down a short ramp.

Angle, deg	1952	1953
9 and 10	–	1
11 and 12	7	6
13 and 14	9 } 66%	16 } 80%
15 and 16	14 }	16 }
17 and 18	1	–
19 and 20	2	1
21 and 22	1	–
23 and 24	1	–
Total	35	40

Miscellaneous Body Items

Door Hinges

In all 1953 cars front doors are hinged at the front. In 1952 two cars had rear-hinged rear doors. This somewhat hazardous design has been completely eliminated in 1953 cars.

Hinged	Front Door		Rear Door	
	1952	1953	1952	1953
At front	All	All	29	40
At rear	–	–	2	–
		Total	31	40

Hood-Release Control

There has been a marked increase in the number of exterior hood-release controls. Apparently the interior control has been found unnecessary.

Type	1952	1953
Interior	14	5
Exterior	22–61%	38–88%
Total	36	43

Hood Counterbalance

More 1953 cars have hood counterbalance arrangements.

	1952	1953
Yes	29–86%	40–98%
No	5	1
Total	34	41

Windshield

More 1953 cars have one-piece curved windshields.

Type	1952	1953
One-piece flat	1	–
Two-piece flat	12	1
Two-piece curved	6	5
One-piece curved	18–49%	40–87%
Total	37	46

Finish

The use of lacquer finish has decreased in 1953. A larger number of cars are using enamel.

Type	1952	1953
Lacquer	23	20
Enamel	13–36%	21–51%
Total	36	41

Rear Window

The number of three-piece curved windows has increased.

Type	1952	1953
One-piece flat	4	2
Three-piece curved	20–54%	28–67%
One-piece curved	13	12
Total	37	42

General Engine Characteristics

Compression Ratio versus Mep and Rpm

Because there was a very definite increase in the compression ratio of the 1953 engines over the 1952 engines, a comparison was made between the average mep's and rpm's for L-head and valve-in-the-head engines made in 1953 for various ranges of compression ratios. This tabulation shows a distinct increase in average mep for the valve-in-the-head engines over the L-head engines for the same compression ratio. This increase in mep in the case of the valve-in-the-head engines is true not only for the condition of maximum torque, but also that of maximum horsepower. It is also interesting to note that there are no L-head engines built as yet having compression ratios greater than 8/1. Engines having compression ratios of 8/1 and greater are all valve-in-the-head designs.

At Maximum Torque

Compression Ratio	L-Head			Valve in Head		
	Average Mep	Average Rpm	No. of Engines	Average Mep	Average Rpm	No. of Engines
6.7 and 6.8	121	1900	4	–	–	–
6.9 and 7.0	124	1830	9	126	1750	2
7.1 and 7.2	126	1740	4	134	2000	3
7.3 and 7.4	134	1800	1	131	1600	1
7.5 and 7.6	119	1600	1	136	1600	2
7.7 and 7.8	136	2200	1	–	–	–
7.9 and 8.0	137	2000	2	140	2200	4
8.1 and 8.2	–	–	–	–	–	–
8.3 and 8.4	–	–	–	180	2700	1
8.5 and 8.6	–	–	–	141	2400	1

At Maximum Horsepower

Compression Ratio	L-Head			Valve in Head		
	Average Mep	Average Rpm	No. of Engines	Average Mep	Average Rpm	No. of Engines
6.7 and 6.8	96	3900	3	–	–	–
6.9 and 7.0	99	3800	9	104	3750	2
7.1 and 7.2	99	3720	4	103	4100	3
7.3 and 7.4	110	3720	2	102	3700	1
7.5 and 7.6	–	–	–	107	3800	2
7.7 and 7.8	103	4000	1	–	–	–
7.9 and 8.0	108	3800	2	113	3910	4
8.1 and 8.2	–	–	–	123	4150	1
8.3 and 8.4	–	–	–	–	–	–
8.5 and 8.6	–	–	–	116	4000	1

Engine Rpm at Maximum Torque

A comparison of the rpm at which maximum torque was developed showed an increase in the rpm for 1953 cars over 1952 cars. It will be noted that 75% of the 1952 cars reached maximum torque at between 1600 and 2100 rpm, whereas only 69% of the 1953 cars reached maximum torque in this speed range. However, the number of cars having maximum torque above 2100 was definitely greater in 1953 than in 1952. It is, therefore, believed that 1953 engines have had a definite increase in the engine speed at which maximum torque is developed.

Rpm	1952	1953
1200 and 1300	2	2
1400 and 1500	3	1
1600 and 1700	8	8
1800 and 1900	7	5
2000 and 2100	12	11
2200 and 2300	1	4
2400 and 2500	2	2
2600 and 2700	–	2
2800 and 2900	–	–
3000 and 3100	1	–
	36	35

Engine Rpm at Maximum Horsepower

A comparison of the engine rpm at maximum horsepower shows that 1953 cars reach maximum horsepower at a somewhat higher speed than 1952 cars. It is rather difficult from this analysis to estimate how much, but it is believed that it is not more than 200 rpm.

Rpm	1952		1953	
3300 and 3400	2		–	
3500 and 3600	16	68%	11	54%
3700 and 3800	7		8	
3900 and 4000	7		11	
4100 and 4200	–		3	
4300 and 4400	2		2	
Total	34		35	

Engine Rpm at 45 Mph

A comparison of engine speeds at which 1953 cars reach 45 mph as compared with 1952 cars shows that the engine speeds are definitely reduced over the 1952 models. This tendency to reduce engine rpm at a given car speed should improve the average fuel mileage of 1953 cars over 1952 cars.

Rpm	1952		1953	
1500 and 1600	–		2	
1700 and 1800	2		7	80%
1900 and 2000	6	16%	9	
2100 and 2200	10		1	
2300 and 2400	2		1	
2500 and 2600	3		–	
2700 and 2800	2		–	
Total	25		20	

Engine Compression Ratio

The tabulation of compression ratios in 1952 and 1953 cars shows a definite increase in the compression ratio of 1953 cars of possibly 0.2 compression ratio. The tabulation also shows a decided increase in the maximum compression ratio used by production cars.

Compression Ratio	1952		1953	
6.5 and 6.6	2		–	
6.7 and 6.8	8		–	
6.9 and 7.0	13	68%	9	
7.1 and 7.2	4		6	70%
7.3 and 7.4	2		2	
7.5 and 7.6	6		4	
7.7 and 7.8	1		1	
7.9 and 8.0	1		6	
8.1 and 8.2	–		1	
8.3 and 8.4	–		–	
8.5 and 8.6	–		1	
Total	37		30	

Thrust to Push Cars in 1953

The figures in this table for thrust to push in 1953 were obtained from the maximum advertised torque and rpm and the maximum advertised horsepower and rpm. It shows that there is a great deal more thrust available at maximum torque than at maximum horsepower. It should be kept in mind that the increase in thrust at maximum torque is the item which gives liveliness, or acceleration, to the car, and it is believed that larger engines are primarily used, not for increased top speed, but for increased acceleration in the driving range. It will be noted in the tables giving the engine rpm at maximum torque and the engine rpm at 45 mph that the maximum torque is obtained fairly close to 45 mph car speed. This means that the acceleration of cars is increased at about 45 mph, which is a very useful speed for car agility, particularly in traffic.

At Rpm of Maximum Torque			At Rpm of Maximum Horsepower		
Thrust, lb/1000 lb weight	No. of Cars		Thrust, lb/1000 lb weight	No. of Cars	
180–200	3		130–150	1	
200–220	9	65%	150–170	7	75%
220–240	4		170–190	8	
240–260	4		190–210	4	
No. of Cars	20		No. of Cars	20	

Pistons

Shape and Coating

The use of oval, or cam-ground, aluminum pistons is 100% in both 1952 and 1953. It is also universal practice to tin plate either aluminum or cast-iron pistons in all engines.

	1952	1953
Oval or Cam Ground	100% aluminum pistons	100% aluminum pistons
Tin Plated	All pistons aluminum and cast iron	All pistons aluminum and cast iron

Material

The use of aluminum as a piston material is predominant. There appears to have been a slight increase in the number of engines using aluminum pistons in 1953 compared to the number using aluminum in 1952, and a reduction in the number of engines using cast-iron pistons.

Material	1952	1953
Aluminum	33–89%	34–94%
Cast iron	4	2
Total	37	36

Piston-Pin Lock

An examination of the number of engines using piston pins locked in the rod and floating in pistons indicates that there is an increase in the number of engines using floating piston pins and the reduction in the number of pistons in which the piston pin is locked either in the rod or the piston.

Locked	1952	1953
In rod	12–37%	10
In piston	2	–
Floating	18–57%	20–67%
Total	32	30

Piston Rings

Number

1953 engines appear to have a fewer number of pistons in which there are two compression rings and two oil rings, and an increased number of engines with two compression rings and one oil ring. This means a reduction in oil rings from 2 to 1, and it will be interesting to note the effect of this trend on oil consumption.

	1952	1953
2 Compression and 1 Oil	14	20–62%
2 Compression and 2 Oil	18–56%	12
Total	32	32

Expanders under Oil Ring

There appears to have been an increase in the number of expanders used under the oil ring, which may also be connected with the reduction in oil rings from 2 to 1. It may be that the use of an expander under a single ring has been found to be as effective and less costly, or more effective at the same cost, than two oil rings. It would be interesting to know what actual experience is in this connection.

	1952	1953
Yes	9–32%	15–47%
No	19	17
Total	28	32

Compression-Ring Coating

There appears to be an indication of an increased use of chrome as a coating on the compression rings, particularly the top compression ring. As there has been but little change in the number of rings that are uncoated, the gain in chrome coating is probably at the expense of other coatings of the phosphate type.

Coating	1952	1953
Chrome (top)	8–32%	12–40%
Other	15–60%	16–53%
None	2	2
Total	25	30

Oil Ring below Piston Pin

There appears to be a definite tendency to eliminate the oil ring located below the piston pin. This elimination of the oil ring below the piston pin may be because it has been found to be much less effective than the piston ring directly below the compression rings and may account for the reduction in number of engines using four piston rings.

	1952	1953
Yes	7	5
No	25–78%	28–87%
Total	32	32

Oil-Ring Coating

Coating on the oil ring seems to have decreased and more oil rings used without any coating than with either phosphate or tin coating.

Coating	1952	1953
Phosphate-tin	11	12
None	13–54%	20–62%
Total	24	32

Miscellaneous Engine Components

Crankshaft Weights

The crankshaft weights for 1952 and 1953 engines were computed in terms of weight of crankshaft per 100 cu in. of cylinder displacement, and it is of interest to note that there is a distinct reduction in the crankshaft weight per unit of cylinder displacement as the in-line engines are changed to V-8 engines, the reduction in crankshaft weight appearing to be about 30%. There is an indication of a slight increase in crankshaft weights between 1952 and 1953 engines.

(Lb of Crankshaft/100 Cu In. Cylinder Displacement)

Type of Engine	1952 Engines			1953 Engines		
	No.	Lb/100 Cu In.		No.	Lb/100 Cu In.	
		Average	Range		Average	Range
Line-4				1	35	
Line-6	9	31.5	28/36	13	32.5	28/36
Line-8	7	31.0	30/36	5	32.7	30/35
V-8	3	20.9	10/23	7	21.6	17/26

Engine Mounting Points

A tabulation of the arrangement of engine mounting points indicates that there is a preference for two engine mounts in the front and one at the rear, and that this preference is increasing in 1953 over 1952. This table also indicates the increase in V-8 engines available in 1953 as compared to 1952, particularly at the expense of in-line 8 engines, the 6 in-line engines remaining about the same in number between 1953 and 1952.

(No. of Engines)

Type of Engine	2 Front 1 Rear		1 Front 2 Rear		2 Front 2 Rear		Total	
	1952	1953	1952	1953	1952	1953	1952	1953
Line-6	7	8	5	5	2	2	14–56%	15–52%
Line-8	5	3	1	1	–	–	6–24%	4
V-8	2	8	1	2	2	–	5	10–34%
Total	14	19	7	8	4	2	25	29

Weight of Piston and Rod Assembly

As a matter of interest the weight of piston and rod assemblies for various engine types and piston materials was computed for both 1952 and 1953. There is no material difference in the weights of the piston-rod assemblies between 1952 and 1953. There appears to be a slight reduction in the case of cast-iron pistons used in 6-in-line engines. The increase in weight of the piston-rod assembly with cast-iron pistons over aluminum pistons is very marked. Also, the low weight of the piston and rod assembly for the V-8 is of significance. In this table it should be noted that this weight of piston and rod assembly is the weight per cubic inch of piston displacement, so that the bore and stroke of the engine are included in the computation.

(Oz/Cu In. Piston Displacement)

Type of Engine	Piston Material	1952		1953	
		No. of Engines	Oz/Cu In.	No. of Engines	Oz/Cu In.
Line-4	Aluminum	1	1.57	1	1.57
Line-6	Aluminum	12	1.17	13	1.17
	Cast iron	4	1.68	1	1.59
Line-8	Aluminum	4	1.43	4	1.43
	Cast iron	1	1.75	–	–
V-8	Aluminum	7	1.14	9	1.16
	Total	29		28	

Rod Bearing Types

The increase in the number of replaceable bearings in the connecting rods is very definite and is almost complete in all engines.

Type	1952	1953
Replaceable	28–90%	31–97%
Cast in	3	1
Total	31	32

Rod Bearing Materials

There has not been much change in the type of rod bearings used in 1953 as compared to 1952, although there is an indication that steel-backed babbitt is increasing and that cast babbitt has disappeared completely.

Type	1952	1953
Babbitt—steel back	23–72%	21–75%
Special alloy—steel back	7–22%	7
Cast babbitt	2	–
Total	32	28

Vibration Dampers

The vibration dampers used on 1953 engines seem to be about the same as those used in 1952. If there is any change, there is a reduction in the number of dampers using rubber hysteresis and an increase in the number of dampers using fluid inertia, either with friction or without. There is also a tendency to increase the number of engines using no damper, possibly due to the increased number of V-8 engines.

Type	1952		1953	
Rubber hysteresis:				
No friction	9	41%	3	32%
With friction	3		8	
Spring-loaded flywheel:				
No friction	2	24%	3	27%
With friction	5		6	
Fluid inertia	2		4	
Flywheel	2		1	
Rubber hysteresis and Fluid inertia and Friction	–		1	
None	6		8	
Total	29		34	

Main Bearing Materials

There has been no change in the main bearing materials used in 1953 and 1952 engines, although there is a definite indication of a predominance of steel-backed babbitt bearings as compared with lead bronze with babbitt face.

Type	1952	1953
Babbitt—steel back	24–73%	24–75%
Lead-bronze-babbitt-faced steel back	8–24%	8
Babbitt-bronze back	1	–
Total	33	32

Valve Gear

Valve-Seat Angles

There has been no change in the valve-seat angles used on either exhaust or inlet valves in 1952 and 1953. The preference for the 30-deg valve-seat angle on the exhaust valve is very evident and the use of the 45-deg angle on the inlet is, in all probability, with the hope of obtaining higher volumetric flow through the valve.

		30 Deg	45 Deg	Total
Inlet	1952	24– 78%	7	31
	1953	24– 75%	8	32
Exhaust	1952	31–100%	–	31
	1953	32–100%	–	32

Valve Rotators

In 1953 there has been an increase in the number of engines using valve rotators. These are universally used on exhaust valves.

	With	Without	Total
1952	4–17%	20	24
1953	8–25%	24	32

Hydraulic Lifters

There has been no apparent change in the number of cars using hydraulic lifters in 1953 over 1952.

	With	Without	Total
1952	9–29%	22	31
1953	10–31%	22	32

Valve-Seat Inserts

There has been no change in the use of valve-seat inserts between 1952 and 1953. No inserts are used on any intake valves and there are more engines built without inserts on the exhaust-valve seats than with them.

		With	Without	Total
Inlet	Not used			
Exhaust	1952	6	19–76%	25
	1953	7	25–78%	32

Valve-Spring Rates

It would appear that the valve-spring rate has been decreased in 1953 over 1952. This would permit the same load at valve-open position for an increase in valve lift.

Spring Rate, lb/in.								
100–140	6		4		6		5	
140–180	3		2		3		3	
180–220	7	56%	12	75%	8	59%	12	65%
220–260	8		9		8		5	
260–300	1		0		1		0	
300–320	2		1		1		1	
Total	27		28		27		26	

Valve Timing

The changes in valve timing in 1953 indicate a trend toward higher speed timing, or one which keeps the valves open longer. The intake valve is being opened a little sooner before top center and being closed a little later after bottom center. The exhaust valve is being opened a little more before bottom center and being closed later after top center.

Intake-Valve Timing

	Opens				Closes			
Deg Btc	1952		1953		Deg Abc	1952	1953	
0–5	1		1		30–40	3	4	
5–10	10	77%	9	67%	40–50	10	11	70%
10–15	14		13		50–60	13	12	
15–20	5		7		60–70	3	4	
20–25	–		1		70–80	1	1	
25–30	1		2		80–90	–	–	
					90–100	1	1	
Total	31		33		Total	31	33	

Exhaust-Valve Timing

	Opens				Closes			
Deg Bbc	1952		1953		Deg Atc	1952	1953	
30–40	1		2		0–10	11	12	
40–50	14	94%	13	85%	10–20	16	15	82%
50–60	15		15		20–30	3	4	
60–70	1		2		30–40	–	0	
70–80	–		1		40–50	1	2	
Total	31		33		Total	31	33	

Valve Lift

In 1953 approximately one-half of the various engines have had changes in the valve lift. The valve-lift changes on both exhaust and inlet valves have been in the neighborhood of 0.015 increase. On the engines where a valve-lift decrease has been reported, it has been about half that amount. These changes in valve lift are, in some cases, possibly due to changes in camshaft timing.

Valve Lift (Change from 1952)

	Increase		Decrease		Change	Total
	No. of Cars	Average Amount	No. of Cars	Average Amount		
Exhaust	6	+0.015	8	0.008	17	31
Inlet	9	+0.017	7	0.007	15	31

Spring Load (Valve Open)

There appears to be but little change between 1953 and 1952 on the spring load on either the inlet or exhaust valves. There also appears to be a very wide variation in the actual spring load at the open position, the load varying more than 2 to 1.

Spring Load, lb	Inlet		Exhaust	
	1952	1953	1952	1953
70 and 80	4	4	4	4
90 and 100	5	4	6	5
110 and 120	7	7	7	8
130 and 140	5	5	5	5
150 and 160	6	7	3	3
170 and 180	1	–	1	1
Total	28	27	26	26

Fuel System

Recommended Fuel (Standard Head)

Approximately one-third of all 1953 cars are supposed to use premium fuel. No information was available on the recommendations for 1952 cars.

	1952	1953
Regular	–	26–70%
Premium	–	11
Total		37

Gas Tank Capacity

There is an increase in gas tank capacity in 1953 cars. The capacity of 90% of 1953 cars is between 17 and 20 gal.

Gal	1952		1953	
13 and 14	2		2	
15 and 16	4		2	
17 and 18	13	80%	17	90%
19 and 20	15		19	
21 and 22	1		–	
Total	35		40	

Availability of Vacuum Booster

The use of vacuum boosters for windshield operation has increased in 1953 cars. The percentage of cars having optional vacuum boosters remains about the same, but there are fewer cars on which no booster is supplied.

Equipment	1952	1953
Standard	9–36%	17–45%
Optional	7–28%	10–26%
None	9	11
Total	25	38

Carburetor

There are less single-barrel carburetors and more four-barrel carburetors on 1953 cars.

Type	1952	1953
Single	16–44%	14–35%
Double	16–44%	18–45%
4-Barrel	3– 8%	7–17%
Side	1– 4%	1– 3%
Total	36	40

Manifold Heat Control

There is no change in the number of cars using automatic heat control as compared with 1952.

Type	1952	1953
Automatic	31–89%	36–90%
None	4	4
Total	35	40

Air Cleaner

There is very little change in the number of cars using oil-bath and oil-wetted air cleaners, although there is a tendency for increased use of the oil-bath air cleaner.

Type	1952	1953
Oil-bath	10–39%	16–42%
Oil-wetted	16	22
Total	26	38

Automatic Choke

There is a slight increase in the number of cars using automatic choke.

Type	1952	1953
Automatic	25–83%	33–89%
None	5	4
Total	30	37

Lubrication System

Main Bearings

All main bearings on 1953 and 1952 engines are lubricated with pressure.

	1952	1953
Pressure	31–100%	33–100%
Total	31	33

Rod Bearings

Rod bearings in 1953 engines are lubricated either by pressure or by jets. All splash lubrication for rods has been eliminated.

	1952	1953
Pressure	28–90%	32–97%
Jet	2– 6%	1
Splash	1	–
Total	31	33

Camshaft Bearings

There has been an increase in the number of 1953 engines whose camshaft bearings are lubricated by pressure, so that in 1953 all engines are lubricated by pressure.

	1952	1953
Pressure	30–97%	33–100%
Splash	1	–
Total	31	33

Piston Pins

1953 engines have had a reduction in the number of wrist pins lubricated by pressure and an increase in those lubricated by splash.

	1952	1953
Pressure	6	4
Splash	18–75%	29–88%
Total	24	33

Timing Gear or Chain

There has been an increase in the number of engines using pressure jet lubrication on the timing gear or chain in 1953.

	1952	1953
Pressure	25–80%	30–91%
Splash	6	3
Total	31	33

Oil-Pump Intake

Stationary oil-pump intakes have increased in number. Percentagewise, floating intakes have decreased slightly.

Type	1952	1953
Floating	19–70%	20–61%
Stationary	8	13
Total	27	33

Oil-Pump Type

All 1953 engines are lubricated with gear-type pumps.

	1952	1953
Gear	20–65%	33–100%
Rotary	10–32%	–
Plunger	1	–
Total	31	33

Cylinder Walls

There are more 1953 engines with jet lubrication on the cylinder walls than there were in 1952. This is accompanied by a corresponding reduction in engines having splash lubrication for the cylinder walls.

	1952	1953
Splash	10	6
Jet	14–58%	27–82%
Total	24	33

Crankcase Capacity

Engines in 1953 cars have a somewhat lower oil capacity than those in 1952 cars. There has been an increase in engines with 4-qt capacity.

Quarts	1952	1953
4	1– 3%	5–15%
5	18–60%	21–64%
5½	2– 7%	1– 3%
6	3–10%	3– 9%
6½	1– 3%	–
7	5–17%	3– 9%
Total	30	33

Oil Pressure

Oil pressure in 1953 engines is reduced over that in 1952 engines, the majority of the engines being lubricated at oil pressure of 35 to 40 psi.

Pressure, psi	1952	1953
35	7–25%	9–28%
40	8–28%	11–34%
45	4–14%	5–16%
50	7–25%	5–16%
55	1– 4%	1– 3%
60	1– 4%	1– 3%
Total	28	32

Tappets

Although there has been little change in the lubrication of the tappets in 1953 engines, there is an apparent indication that the splash lubrication gained some ground.

	1952	1953
Pressure	14–56%	17–52%
Splash	11	16
Total	25	33

Oil Filters

The number of engines equipped with part-flow filters has increased, and the number of engines with no oil filter has decreased. There has been a slight decrease in the percentage of cars using full-flow filters, although the actual number of full-flow filters is up from 8 to 10.

Type	1952	1953
Part-flow	8–38%	18–56%
Full-flow	8–38%	10–31%
None	5	4
Total	21	32

Electrical System

Regulated Voltage

The use of 12-v systems has entered the picture in 1953 and there has been an apparent increase in the voltage regulator 6-v systems so that the regulated voltage has been raised approximately half a volt.

Voltage	1952		1953	
7.4– 7.7	27	100%	20	86%
7.8– 8.1	1		6	
14.8–15.1	–		4	
Total	28		30	

Breaker Gap

The breaker gap on the 1953 engines has been increased over the 1952.

Gap, in .001 in.	1952		1953	
13–14	1	41%	1	23%
15–16	13		6	
17–18	4	38%	9	61%
19–20	9		10	
21–22	6		4	
23–24	–		–	
24–25	1		1	
Total	34		31	

Breaker Tension

It would appear that 1953 cars have a higher breaker tension than 1952, possibly to take care of an increase in engine rpm.

Tension	1952		1953	
18	10		–	
19	16	68%	25	100%
20	–		–	
21	5		7	
Total	31		32	

Cam Angle

The cam angle of the 1953 engines has been increased very little over 1952. This, together with the breaker gap, may be a combination to improve ignition at high speeds.

Angle, deg	1952		1953
25–30	6	48%	6
30–35	7		4
35–40	13		10
40–45	–		2
45–50	1		–
Total	27		32

Generator Drive Ratio

1953 engines have a higher generator drive ratio than 1952 engines, probably about 10%.

Ratio	1952	1953
1.4–1.5	1	1
1.6–1.7	2	4
1.8–1.9	14	12
2.0–2.1	6	13
2.1–2.2	1	1
Total	24	31

Starter Drive Engagement

The use of an overrunning clutch has gained definitely and is possibly associated with the use of the ignition key for starting.

Type	1952	1953
Over-running clutch	16–62%	23–74%
Sliding gear	3	2
Sliding gear & Over-running clutch	7	6
Total	26	31

Generator Output (Maximum)

There is a definite indication that an effort has been made to increase the maximum wattage output of the generators in 1953. The actual increase is probably not more than 10%.

Watts	1952	1953
250–300	4–19%	4–14%
300–350	5–24%	8–27%
350–400	5–24%	4–14%
400–450	5–24%	8–27%
450–500	1–4.5%	5–18%
500–550	1–4.5%	–
Total	21	29

Centrifugal Advance Starting Rpm

The rpm at which the centrifugal advance starts on 1953 engines is definitely higher than in 1952, possibly 200 rpm.

Rpm	1952		1953	
200–300	2		–	
300–400	11	64%	11	59%
400–500	4		3	
500–600	3		4	
600–700	7		8	
700–800	–		2	
800–900	–		2	
Total	27		30	

Minimum Generating Rpm

There appears to be a tendency to reduce the minimum generating rpm in 1953. The reduction would appear to be 300 or 400 rpm.

Rpm	1952		1953	
500–1000	6		4	
1000–1500	5	52%	8	59%
1500–2000	2		4	
2000–2500	9		9	
2500–3000	1		2	
3000–3500	2		–	
Total	25		27	

Starter Drive Ratio

The starter drive ratio of 1953 engines is definitely greater than 1952. This could be due to an increase in the number of larger engines, or also a desire to permit higher starting motor rpm.

Ratio	1952		1953	
12–13	4		1	
13–14	2		1	
14–15	6		9	
15–16	5	67%	6	93%
16–17	9		13	
17–18	3		–	
Total	29		30	

Starting Procedure

The use of the ignition key as a starting device has definitely increased in 1953 over 1952. The use of the push button on the dash and also the clutch switch appear to have lost ground.

Act	1952	1953
Turn key	15–47%	21–65%
Depress accelerator	4	5
Push button	8	4
Depress clutch	5	2
Total	32	32

Rpm at Maximum Advance

The engine rpm at maximum advance has been increased in 1953 over 1952. This is probably to increase fuel mileage at higher speeds.

Rpm	1952		1953	
500–1000	1		–	
1000–1500	6	53%	5	37%
1500–2000	8		6	
2000–2500	2		4	
2500–3000	3	34%	7	56%
3000–3500	4		6	
3500–4000	2		2	
Total	26		30	

Maximum Centrifugal Advance

There has been an increase in the maximum centrifugal advance in 1953 engines over 1952.

Advance, deg	1952		1953	
5–10	4		1	
10–15	9		11	
15–20	6	66%	9	75%
20–25	3		5	
25–30	1		4	
30–35	4		3	
Total	27		33	

Maximum Vacuum Advance

The maximum number of degrees advance available at high vacuum has been very definitely increased in 1953 over 1952, possibly 10 degrees.

Advance, deg	1952		1953	
0–5	3		–	
5–10	13	95%	–	
10–15	2		13	90%
15–20	–		14	
20–25	1		3	
Total	19		30	

Vacuum at Start of Advance

There has been a reduction in the vacuum at the time spark advance starts. This might be expected with engines with high volumetric efficiency.

Vacuum, in. Hg	1952		1953	
2–3	–		1	
4–5	11	68%	17	84%
6–7	6		8	
8–9	4		2	
10–11	1		1	
12–13	3		1	
Total	25		30	

Vacuum at Maximum Advance

The vacuum at maximum advance has practically remained unchanged between 1953 and 1952. It is very close to the maximum vacuum at idle.

Vacuum, in. Hg	1952		1953	
9–10	3		4	
11–12	6		6	
13–14	4		3	
15–16	8		8	
17–18	3	50%	4	57%
19–20	2		3	
21–22				
Total	26		28	

Exhaust System

Muffler

In 1953 the reverse flow muffler has apparently gained in popularity over the straight through muffler.

Type	1952	1953
Straight through	9	8
Reverse flow	15–63%	25–76%
Total	24	33

Tail Pipe

The number of tail pipes in which the diameter is the same as the exhaust has decreased, and the number of cars in which the tail pipe is smaller than the exhaust pipe has increased. This may be an indication that quietness is being sought rather than reduction in exhaust back pressure.

Type	1952	1953
Same diameter as exhaust	10	4
Smaller than exhaust	23–70%	24–86%
Total	33	28

Timing Mark Location

There has been no particular change in the popularity of places for locating the timing mark on engines. The vibration damper still is the most popular location.

Location	1952	1953
Vibration damper	12	19
Flywheel	3	2
Crank fan pulley	2	7
None	4	2
Total	21	30

Ignition

Spark Plug Thread

Fourteen millimeter spark plug thread is used on all 1952 and 1953 plugs.

Size, mm	1952	1953
14	All	All

Spark Plug Protection

There has been an increase in the use of synthetic or rubber nipples for spark plug protection.

Type	1952	1953
None	4	4
Synthetic or rubber nipple	15	23
Metal cover	5	5
Total	24	32

Spark Plug Tightening Torque

There has been but little change in the spark plug tightening torque between 1953 and 1952. It is quite astonishing that there is as much variation in torque to tighten plugs, particularly for the same size plug, and it might be very desirable for the SAE to consider the possibility of standardizing spark plug tightening torque. It would appear that a variation of 50% in tightening torque is hardly necessary.

Torque, lb-ft	1952		1953	
22 and 23	3		3	
24 and 25	2		3	
26 and 27	1		5	
28 and 29	9	79%	11	71%
30 and 31	14		16	
Total	29		38	

Spark Plug Gap

There is an indication that the spark plug gap has been increased in 1953 over 1952. This, if true, is probably for fuel economy reasons.

Gap, in.	1952	1953
0.025 and 0.026	8	7
0.027 and 0.028	–	–
0.029 and 0.030	7	7
0.031 and 0.032	9	7
0.033 and 0.034	–	–
0.035 and 0.036	12–33%	16–43%
Total	36	37

Electrical Suppression

The provisions for suppression of electrical disturbance is astonishingly varied among the various cars. In some cases one point is suppressed, in other cases five, and there are nine locations at which suppression is being applied. In 1953 there are no cars without any provision whatever for electrical suppression. Two points which seem to have received most general acceptance for the application of suppression units are the generator and the distributor.

	No. of Points											
	0	1	1	1	2	3	3	3	4	5	5	5	Total
Location of Points													
Distributor	–	X	–	–	X	X	X	–	X	X	X	–	7
Coil	–	–	X	–	–	X	–	–	X	X	–	–	4
Nonmetallic cable	–	–	–	X	–	–	–	X	–	–	X	X	4
Spark plugs	–	–	–	–	X	–	–	–	–	–	–	–	1
Generator	–	–	–	–	–	X	X	X	X	X	X	X	7
Ignition switch	–	–	–	–	–	–	X	X	–	–	–	–	2
Voltage regulator	–	–	–	–	–	–	–	–	X	X	X	X	4
Engine ground	–	–	–	–	–	–	–	–	–	X	X	X	3
Wheel static	–	–	–	–	–	–	–	–	–	–	–	X	1
No. of cars 1952	3	2	1	–	4	1	1	–	2	–	–	–	14
No. of cars 1953	–	4	1	1	4	–	1	1	–	1	1	1	15

Cooling System

Radiator Cap Relief Valve Setting

In 1953 there has been a tendency to increase the pressure of the relief valve setting.

Pressure, psi	1952	1953
4	3–10%	5–13%
7	24–86%	31–77%
12–14	1	4
Total	28	40

Radiator Core

There is no change of any consequence in the type of radiator core used in 1953 as compared with 1952.

Type	1952	1953
Cellular	23–57%	19–56%
Fin and tube	17	15
Total	40	34

Thermostat

In 1953 there has been a reduction in the number of by-pass installations and an increase in the number of choke type installations.

Type	1952	1953
By-pass	17–61%	12–30%
Choke	11	28
Total	28	40

Fan Belt

There has been a definite increase in the use of the narrow (3/8-in.) fan belt in 1953.

Type	1952	1953
Narrow 3/8 in.	23–72%	25–81%
Wide 5/8 in.	9	6
Total	32	31

Water Jacket

There has been a slight increase in the number of engines using the full length water jacket in 1953 over 1952. There has been no change in the number of engines using water all the way around the barrels in 1953 over 1952.

Type	1952	1953
Full length		
Yes	29–85%	37–92%
No	5	3
Total	34	40
Water All around Barrels		
Yes	22–65%	26–65%
No	12	14
Total	34	40

Thermostat Setting

There has been no change of any significance between the settings for 1953 and 1952.

Temperature, F	1952	1953
150–155	14 } 82%	15 } 82%
155–160	9 }	15 }
160–165	1	5
165–170	4	2
Total	28	37

Capacity (with Heater)

There has been no material change in the capacity of the cooling system in 1953 over 1952.

Quarts	1952	1953
10–15	7– 21%	8– 20%
15–20	15 } 70%	15 } 74%
20–25	9 }	15 }
25–30	1	2
30–35	2	–
Total	34	40

By-Pass Recirculation

There has been an increase in the number of internal by-pass recirculation installations in 1953.

Type	1952	1953
Internal	12–42%	25–60%
External	8	8
None	9	7
Total	29	40

Transmissions

Type Available

In general in 1953, as well as 1952, overdrive and automatic transmission were available as optional on most cars. However, on some cars standard conventional transmissions were not available and automatic transmissions were standard equipment. There has been no significant change in the availability of transmissions in 1953 over 1952.

Type	Conventional		Conventional with Overdrive		Automatic	
	1952	1953	1952	1953	1952	1953
Standard	24	24	–	–	4	5
Optional	–	–	15	16	17	19
Not available	4	5	11	13	6	5
Total	28	29	26	29	27	29

Conventional Transmission Ratios

There has been no significant change in conventional transmission ratios between 1952 and 1953.

Low Ratio	1952	1953	Second Ratio	1952	1953	Reverse Ratio	1952	1953
2.3–2.4	3	4	1.5–1.6	7	7	2.3–2.4	1	1
2.5–2.6	16	15	1.6–1.7	11	10	2.5–2.6	1	2
2.7–2.8	3	3	1.7–1.8	1	–	2.7–2.8	–	–
2.9–3.0	1	2	1.9–2.0	5	7	2.9–3.0	3	4
						3.1–3.2	3	1
Total	23	24	Total	24	24	3.3–3.4	8 } 68%	10 } 70%
						3.5–3.6	9 }	5 }
						Total	25	23

Conventional Transmissions

Lubricant Capacity

There has been an increase in the lubricant capacity of the standard transmission in 1953 over 1952. The increase, however, is quite small.

Capacity, pt	1952	1953
1–2	9	7
2–3	11–46%	14–56%
3–4	4	3
Total	24	24

Constant Mesh Second Speed Gears

Constant mesh second speed gears were used on all 1952 and 1953 transmissions.

Type	1952	1953
Helical	All	All

Engagement of Second and Direct Gears

The engagement of the second and direct gears in 1952 and 1953 was with synchromesh construction in all cases.

Type	1952	1953
Synchromesh	All	All

Overdrive Transmissions

Overdrive Cut-In Speed (Minimum)

There has been no change in the minimum cut-in speed of the overdrive in 1953 over 1952 cars. It has been approximately 24 to 28 miles.

Mph	1952	1953
22–24	1	2
24–26	4 } 63%	7 } 67%
27–28	1 }	3 }
29–30	2	3
Total	8	15

Overdrive Gear Ratios

There has been no change in the overdrive gear ratios between 1953 and 1952.

Ratio	1952	1953
0.70	13	15
0.72	2	1
Total	15	16

Overdrive Control

The lockout manual control and accelerator down shift is used on all overdrive transmissions in both 1952 and 1953.

Control	1952	1953
Manual lockout	All	All
Accelerator down shift	All	All

Automatic Transmissions

General Types

Although there has been an increase in the total number of cars equipped with automatic transmissions in 1953 over 1952, the proportion of transmissions using torque converters and using fluid couplings has remained the same.

Types	1952	1953
Torque converter and gears	9	13
Fluid coupling and gears	10	12
Total	19	25

Manual Selector Positions

The manual selector positions for the combinations of fluid coupling and planetary gears are reasonably well standardized. The neutral is on the left-hand end and the reverse on the right-hand end, the forward speeds being in the intermediate positions and having the lower gear on the reverse side, just ahead of the lockout into reverse.

In the manual selector positions for the torque converters and planetary gears, there is a difference in that the reverse is at one end of the selector in one group of transmissions and next to park in the other group.

In both cases, however, the parking position is at the extreme left so that there is no confusion in actually parking the car and setting the braking device. The position for the manual selector for torque converters and sliding gears is distinctly different from that used with planetary gear sets. It would seem desirable to have agreement on a standard method of arranging the manual selector.

Position Arrangements	1952	1953
Fluid coupling and gears (planetary)		
(Neutral-direct 1-direct 2-low) reverse	1	6
(Neutral-direct-low) reverse	4	1
Torque converter and gears (planetary)		
Park-(neutral-direct-low) reverse	6	7
Park-reverse (neutral-direct-low)	–	3
Torque converter and gears (sliding)		
Reverse-low-neutral-direct	2	6
Total	13	23

Torque Converters . . . Maximum Torque Ratio

There is a definite tendency for 1953 cars to have an increased torque ratio in the torque converter. It would appear to amount to possibly two-tenths of a ratio.

Ratio	1952	1953
2.1–2.2	4	6
2.3–2.4	3–43%	2 } 50%
2.5–2.6	–	4 }
Total	7	12

Downshift Possible Up To

There has been no material change in the car speed at which a downshift is possible.

Mph	1952	1953
40–50	8	8
50–60	3 } 43%	6 } 60%
60–70	4 }	9 }
70–80	1	2
Total	16	25

Torque Converters . . . Rpm at Stall

The 1953 torque converters appear to be stalling at a slightly lower speed so that there is an indication that not only is the torque ratio increasing, but also the capacity of the converter is increasing.

Rpm	1952	1953
1300–1400	3–43%	8–57%
1500–1600	3	4
1600–1700	1	2
Total	7	14

Forced Shift by Governor

There has been an increase in the number of transmissions using a forced shift by governor in 1953 over 1952.

	1952	1953
Yes	8–50%	16–64%
No	8	9
Total	16	25

Gear Ratios of Automatic Transmissions

This table shows the gear ratios in all automatic transmissions now in use, there being a total of seven transmissions, although some are used in more cars than others. The most popular design appears to be the fluid coupling with planetary gears.

	Low	Second	Third	Reverse	1952	1953
Torque converter gears (planetary)	1.82	–	–	1.82	2	2
	1.82	–	–	1.62	1	1
	2.44	–	1.48	2.00	–	2
	2.31	–	1.43	2.00	1	1
Torque converter gears (sliding)	3.28	2.04	1.61	3.69	1	3
Fluid coupling gears (planetary)	3.82	2.63	1.45	4.30	6	7
Fluid coupling gears (sliding)	3.57	2.04	1.75	3.99	1	3

Cooling of Converter

In 1953 there has been an increase in the number of cars with air cooled converters.

Type	1952	1953
Water	5	4
Air	2	5
Total	7	9

Mechanical Lock-up

There has been an increase in the number of cars with no mechanical lock-up provided in 1953 over 1952.

Provided	1952	1953
Yes	3	3
No	5	11
Total	8	14

Shift Within Drive Range With Accelerator and Governor

There has been no change between 1953 and 1952.

	1952	1953
Yes	13–81%	23–92%
No	3	2
Total	16	25

Speeds of Mechanical Lock-Up and Release

There is no change between 1953 and 1952.

Mph Lock-Release	1952	1953
15 14	1	1
18 15	1	1
21 18	1	1
Total	3	3

Anti-Creep Device

The number of cars provided with an anti-creep device has been increased in 1953.

Provided	1952	1953
Yes	6–75%	12–86%
No	2	2
Total	8	14

Number of Elements in Torque Converter

The number of elements in the 1953 torque converters has been reduced over that used in 1952. The five element units used in 1952 have been discontinued in 1953.

No.	1952		1953	
3	2	63%	6	100%
4	3		9	
5	3		–	
Total	8		15	

Oil Capacity

The oil capacity of the transmission for complete refill has been increased slightly in 1953, possibly one, or two pints.

Refill, pt	1952		1953	
3 (Gear box only)	4		5	
14 and 15	4		5	
16 and 17	1		–	
18 and 19	3	54%	6	67%
20 and 21	2		3	
22 and 23	2		5	
24 and 25	1		2	
Total	13		21	

Clutch

Clutch Plate Pressure

In 1953 there has been an increase in average clutch plate pressure in pounds per square inch over that used in 1952.

Pressure, psi	1952		1953	
13 and 14	6	73%	9	85%
15 and 16	2		7	
17 and 18	6		7	
19 and 20	1		2	
21 and 22	3		1	
23 and 24	1		1	
Total	19		27	

General Type

There has been no change in the general type of clutch in 1953 over 1952.

Type	1952	1953
Disc	20–71%	24–71%
Fluid coupling	4	3
Semi-centrifugal	4	7
Total	28	34

Clutch Springs

There has been no significant change in the type of the clutch spring used in 1953 over 1952.

Type	1952	1953
Coil	24	29
Diaphram	4	5
Total	28	34

Rear Axle

Gear Type

In 1953 all axles are hypoid. In 1952 there was one axle of a spiral gear design.

Type	1952	1953
Hypoid	33	40
Spiral	1	–
Total	34	40

Ratio of Overdrive Axle Ratio/ Conventional Axle Ratio

1953 cars have an axle ratio for the overdrive that is closer to the conventional axle ratio than that used in 1952.

Ratio	1952		1953	
1.05–1.10	2	5–50%	1	13–87%
1.10–1.15	5		13	
1.15–1.20	3		1	
Total	10		15	

Ratio of Automatic Axle Ratio/ Conventional Axle Ratio

There has been a tendency to move the axle ratio for automatic transmissions closer to the axle ratio used in the conventional transmissions.

Ratio	1952		1953	
0.6–0.7	–	60%	1	43%
0.7–0.8	3		5	
0.8–0.9	3		2	
0.9–1.0	1		3	
1.0	3		5	
Total	10		16	

Lubricant Capacity

There has been no change in the lubricant capacity of the axles between 1952 and 1953.

Pints	1952		1953	
1–2	1	80%	–	80%
2–3	2		5	
3–4	24		25	
4–5	3		7	
5–6	4		3	
Total	34		40	

Propeller Shaft

Type of Propeller Shaft

There has been a slight increase in the number of cars using an exposed propeller shaft in place of a torque tube in 1953 over 1952.

Type	1952	1953
Torque tube	6	6
Exposed	22	34
Total	28	40

Number of Universals Used

There has been no change in the number of universals used in 1953 and 1952.

Number	1952	1953
1	2	3
2	11	11
3	4	5
Total	17	19

Number Used by Car Makes

There has been no change in the percentage of cars using two propeller shafts in place of one.

Number	1952	1953
1	9	14
2	4	5
Total	13	19

Brakes

Service Brakes

All service brakes in 1952 and 1953 were the hydraulic type.

Type	Hydraulic
1952	All
1953	All

Power Brakes

All power brakes in 1952 and 1953 were the vacuum boost type and there has been a slight increase in the number of installations in 1953 over 1952.

Type	Vacuum Boost
1952	6
1953	7

Brake Lining Attachment

There is no change in the number of cars using riveted and bonded brake lining attachments in 1953 and 1952.

Type	1952	1953
Rivets	18	23
Bonded	8–31%	10–30%
Total	26	33

Ratio of Front Brake Cylinder Diameter/ Rear Brake Cylinder Diameter

There has been no change between 1953 and 1952. The predominant ratio is about 1.2 larger diameter on the front brake cylinder.

Ratio	1952		1953	
1.0–1.1	6		4	
1.1–1.2	17	74%	9	75%
1.2–1.3	3		6	
1.3–1.4	1		1	
Total	27		20	

Brake Drum Material

There has been a reduction in the number of cast-iron drums used in 1953 over that used in 1952, and an increase in 1953 of the composite or centrifuge-type drum.

Material	1952	1953
Cast iron	32	16
Composite	2	2
Centrifugal	–	9
Aluminum	1	1
Total	35	28

Front and Rear Brake Drum Size

There is no significant change between 1953 and 1952.

Relation	1952	1953
Same	31	31
Front larger	2	1
Total	33	32

Parking Brakes

There has been no significant change in the location of the parking brakes in 1953 and 1952.

On	1952	1953
Rear wheels	26	24
Transmission	8	9
Total	34	33

Brake Pedal Travel

There is an indication that in 1953 the brake pedal travel has been increased over that in 1952.

Travel, in.	1952	1953
4–5	2	2
5–6	3	2
6–7	10 } 81%	13 } 88%
7–8	11 }	16 }
Total	26	33

Line Pressure at 100-Lb Pedal Load

There has been no material change in the line pressure in 1953 over 1952, although in both years there are several cars with quite high line pressure. These are probaby equipped with boosters.

Psi	1952	1953
500 and 600	10 } 74%	13 } 75%
700 and 800	7 }	11 }
900 and 1000	5	6
1100 and 1200	1	–
1300 and 1400	–	2
Total	23	32

Steering

Type Available

In 1953 the increase in optional power steering was very marked. The number of cars with mechanical steering only was very definitely reduced.

Type	1952	1953
Mechanical only	26	14
Power only	1 } 26%	1 } 67%
Power optional	8 }	27 }
Total	35	42

Steering Wheel Diameter

There has been an increase of possibly an inch in steering wheel diameter in 1953 cars.

Diameter, in.	1952	1953
15–16	3	–
16–17	–	–
17–18	3	3
18–19	21–78%	32–91%
Total	27	35

Drag Link

There has been no significant change between the installations on 1953 and 1952 cars.

Type	1952	1953
Transverse	17–49%	19–45%
Longitudinal	13	13
None	5	10
Total	35	42

Overall Steering Ratio

There was no significant change in steering ratio of the mechanical-steering gears in 1953 and 1952 cars. However, in the case of the power-steering gears, there was a decrease in the overall steering ratio in 1953 as compared to 1952. The majority of cars with power steering have approximately the same overall ratio as those with mechanical steering.

Ratio	Mechanical		Power	
	1952	1953	1952	1953
15 and 16	–	–	2	6
17 and 18	–	–	–	–
19 and 20	2	1	–	2
21 and 22	6	5	–	8
23 and 24	5	7	–	–
25 and 26	10–40%	18–45%	6–75%	11–41%
27 and 28	1	3	–	–
29 and 30	1	6	–	–
Total	25	40	8	27

Turning Diameter

Wall to Wall

In 1953 there appears to have been an increase in wall-to-wall turning diameter of cars.

Diameter, ft	1952		1953	
30–35	2		–	
35–40	3		1	
40–45	9	65%	8	93%
45–50	2		5	
50–55	1		–	
Total	17		14	

Curb to Curb

There has also been an increase in curb-to-curb turning diameter in 1953.

Diameter, ft	1952	1953
35–40	10	8
40–45	9–45%	15–60%
45–50	1	2
Total	20	25

Outside Wheel Angle with Inside Wheel Angle at 20 Deg

In 1953 there has been a reduction in the outside wheel angle when the inside wheel angle is at 20 deg. This may account for some of the increase in turning diameter.

Angle, deg	1952	1953
17 and 18	17–65%	31–82%
19 and 20	1	5
21 and 22	1	–
23 and 24	7	2
Total	26	38

Ratio of Power Steering Ratio/ Mechanical Steering Ratio

The number of cars with power steering in 1952 makes it impossible to draw conclusions concerning changes in the ratio of power steering ratio to mechanical steering ratio.

Ratio	1952	1953
0.6–0.7	–	2
0.7–0.8	1	2
0.8–0.9	–	3
0.9–1.0	1	2
1.00	2	2
1.0–1.1	–	1
Total	4	12

Rear Suspension

Spring Rate at Wheel

The spring rate at the wheel of 1953 cars decreased. This should give an improvement in ride.

Rate, lb/in.	1952		1953	
90–100	1		–	
100–110	2		5	
110–120	6	79%	8	67%
120–130	5		2	
Total	14		15	

Type Spring

More 1953 cars are fitted with a longitudinal leaf on the rear spring. Less cars employ a coil.

Type	1952	1953
Coil	5	3
Longitudinal leaf	25–83%	31–91%
Total	30	34

Rear Shock Absorbers

There was no significant change in the type of rear shock absorbers used in 1952 and 1953 cars.

Type	1952	1953
Link	3	2
Direct-acting	26–90%	32–94%
Total	29	34

Front Suspension

Type

The independent suspension with coil springs is used on all 1952 and 1953 cars.

Type	Type 1952	1953
Independent with coil springs	All	All

Shock Absorbers

There has been no significant change in shock absorbers. The direct-acting type still predominates.

Type	1952	1953
Direct-acting	24–86%	38–90%
Link	4	4
Total	28	42

Spring Rate at Wheel

The spring rate at the front wheel of 1953 cars has been reduced over that of 1952 cars. This will probably improve ride.

Lb/in.	1952	1953
80 and 90	3	10
100 and 110	8–61%	11–44%
120 and 130	2	4
Total	13	25

Stabilizer

The linkless type of stabilizer has increased in use.

Type	1952	1953
Link	12	15
Linkless	11–39%	24–59%
None	5	2
Total	28	41

Tires

Rear Tire Pressure

In 1953 the rear tire pressure has been reduced over that used in 1952.

Psi	1952	1953
20–21	–	1
22–23	2	4
24–25	31–91%	23–77%
26–27	–	1
28–29	1	1
Total	34	30

Relation Front and Rear Tire Pressure

In 1953 there are a few more cars with tire pressures higher on the front wheels than the rear, than there were in 1952.

Relation	1952	1953
Same	27–79%	22–72%
Front higher	7	8
Total	34	30

Front Tire Pressure

In 1953 the front tire pressure has been increased slightly over 1952.

Psi	1952	1953
24	26–76%	22–73%
25	1	–
26	5	7
27	–	–
28	2	1
Total	34	30

TECHNICAL COMMITTEE *Progress*

Revised Standard on Rubber Compounds To Appear in May in 1953 SAE Handbook

by **N. L. Catton,** Chairman
Subsection IV-D—Revision of Tables,
SAE-ASTM Technical Committee on Automotive Rubber

THE SAE Standard on Rubber and Synthetic - Rubber Compounds for Automotive and Aeronautical Applications (SAE 10R) has been revised and will appear in its new form in the 1953 SAE Handbook due off the presses late in May.

The changes were drawn up by the SAE-ASTM Technical Committee on Automotive Rubber and approved by the SAE Nonmetallic Materials Committee and the SAE Technical Board, as well as by the appropriate groups in the American Society for Testing Materials. The revised SAE standard will be in agreement with the 1953 version of ASTM D735. It includes rubber compounds for applications other than tires, inner tubes, sponge rubber, belts, hose, mats, hard rubber, insulated wire and cable, and rubber goods prepared from latex.

In former versions of these specifications, an attempt was made to segregate natural rubber compounds from those made from GR-S. In the present revision this segregation is discontinued. Rubber and synthetic rubber compositions are divided into two basic types: Those requiring no specific resistance to the action of petroleum-base fluids are identified as Type R; and those requiring specific degrees of resistance identified as Type S.

This year a new classification of synthetic rubber compounds has been added. This classification, identified as Type T, describes compositions having specific resistance to the effect of prolonged exposure to abnormal temperatures and to compounded petroleum oils. Type R compounds are not further described as to classes of elastomers, and it is the Committee's intention that they be prepared using natural, reclaim, and synthetic rubber, or mixtures thereof, as the base, provided the requirements of the specifications are met.

The Type S compositions, which are normally used where resistance to swelling action by oil is required, are subdivided into three classes:

Class SA describes compositions having very low volume swell in petroleum hydrocarbons. In practice such compounds are normally made from polysulfide-organic dihalide polymers (Thiokol).

Class SB compounds are characterized as having low volume swell in petroleum hydrocarbons and normally describe compounds made from copolymers containing acrylonitrile.

Class SC describes compounds having medium volume swell in petroleum hydrocarbons. Such compounds are normally made from neoprene as the base material.

Type T compounds are divided into two classes:

Class TA compounds are intended for services where outstanding resistance to change by extreme heat and cold are required. These compositions are normally made from silicone.

Class TB compounds are intended for services where outstanding resistance to change by severe heat and in hot petroleum hydrocarbons, including those modified with sulfur compounds, is required. These compositions are normally made from polyacrylic rubbers as the base material.

The specifications further provide for different grades within each class. The grades are designated by a number representing the hardness and tensile strength properties of the stock. In the former versions of these spec-

These reports have recently been approved by the SAE Technical Board . . .

SURFACE FINISH CONTROL—This new SAE Recommended Practice gives information on the use of roughness comparison specimens. It will be published in the SAE Handbook following the present Surface Finish Standard, which appears in pp. 178-180 of the 1952 Handbook. The Surface Finish Standard set up precision reference specimens using a controlled surface profile to obtain reproducible roughness values. These specimens were developed for instrument calibration. The new Recommended Practice sets up a second grade of standards, functional in nature, for the specific product being manufactured.

SQUARE AND HEXAGON BOLTS AND NUTS—This SAE Standard has been revised by the SAE Screw Threads Committee to make it conform with the latest revisions of the American Standard B18.2-1952 Square and Hexagon Bolts and Nuts.

ifications, these properties constituted the basic requirements for the non-oil resistant Class R. In the present revision, resistance to change in hardness and tensile strength properties after oven aging has been retained as a basic requirement. The former compression set requirement specified as Suffix "B" has been retained as part of the basic requirements and the values for Suffix "B" compression set as in last year's version require for their fulfillment the development of low set types of compounds. Another change has been in the suffix letter designations for low-temperature requirements. Suffix "F" requiring low-temperature test at −40 F is now identified as Suffix "F_1," likewise Suffix "FF" requiring low temperature test at −65 F is now Suffix "F_2."

In the tables for oil-resistant Type S compounds, basic requirements formerly included hardness, tensile strength, and elongation and the change in volume after aging in oil. In the revised specifications, change in volume in both high and low aniline point oils, change in tensile strength, elongation and hardness after aging in the air oven, and compression set have been retained as basic requirements. Compression set under the Suffix "B" has been continued and requires the development of stocks especially compounded to have low compression set characteristics.

The following suffix letters designating additional quality requirements have been provided so that the purchaser may specify requirements in addition to the basic requirements. These suffix requirements may be applied singly or in combination in further describing any grade. These additional suffix letters and their requirements are:

C
Weather resistance test. As yet no standard method is available.

D
Load deflection test. Values have been established for Type R compounds only and the test is conducted in accordance with "Standard Methods of Test for Compression-Deflection Characteristics of Vulcanized Rubber" (ASTM Designation: D575).

E_1
Oil immersion test. Values are specified for Classes SA, SB, SC, and TA. These tests are made in ASTM Petroleum-Base Oil No. 1 as specified according to "Tentative Methods of Test for Changes in Properties of Rubber and Rubber-Like Materials in Liquids" (ASTM Designation: D471).

E_3
Oil immersion test. Values are specified for Classes SA, SB, SC, and TA. These tests are made in ASTM Petroleum-Base Oil No. 3 as specified according to "Tentative Methods of Test for Changes in Properties of Rubber and Rubber-Like Materials in Liquids" (ASTM Designation: D471).

E_4
Oil immersion test. Values are specified for Class TB. Tests are made in a blend of Petroleum-Base Oil No. 1 and a hydrocarbon composition containing sulfur and chlorine constituents of controlled activity toward metal surfaces. This composition is a typical additive for extreme pressure lubricants. The test is made according to the methods of ASTM Designation D471, "Tentative Methods of Test for Changes in Properties of Rubber and Rubber-Like Materials in Liquids."

F_1
Low-temperature tests at -40 F. This is a brittleness test conducted according to "Tentative Method of Test for Low Temperature Brittleness of

Technishorts . . .

J. H. Best

LESS BREAKAGE OF DELICATE AERO EQUIPMENT IN TRANSIT is what this man—Bendix Radio Division's J. H. Best—has in mind these days. That's because he has just been appointed chairman of SAE Committee S-8 on Aircraft Equipment Shock and Vibration Isolation. And S-8 has set as its goals the:

- Division of all instruments, electronic gear, and similar fragile items into groups based on fragility.
- Determination of shock and vibration testing procedures that will permit such ratings to be made.
- Development of simple formulas, nomographs, and other procedures for determining proper amount and type of packaging for equipment so rated.

ENGINE COOLING MANUAL—No whiskers are going to get a chance to grow on the SAE manual covering maintenance of automotive engine cooling systems. The SAE T&M Technical Committee is going to see to that. It has reactivated the SAE Cooling System Maintenance Subcommittee and asked it to revise where necessary the information in this primer on:

- Construction, function, and operation of cooling systems.
- Driver or operator preventive maintenance.
- Mechanic preventive maintenance.
- Trouble shooting procedures.

Subcommittee chairman will again be D. H. Green, of Union Carbide and Carbon Corp. It was Green who suggested that the manual be revised and brought completely up to date.

Rubber and Rubber-Like Materials" (ASTM Designation: D736).

F_2
Low-temperature tests at -65 F. This is a brittleness test conducted according to "Tentative Method of Test for Low Temperature Brittleness of Rubber and Rubber-Like Materials" (ASTM Designation: D736).

G
Tear test. No values are specified. However, the test is conducted according to "Standard Methods of Test for Tear Resistance of Vulcanized Rubber" (ASTM Designation: D624).

H
Flexing test. No values are specified. However, the test is conducted according to "Tentative Methods of Test for Dynamic Ply Separation and Cracking of Rubber Products" (ASTM Designation: D430).

J
Abrasion test. No values are specified. However, the test is conducted according to "Tentative Methods of Test for Abrasion Resistance of Rubber Compounds" (ASTM Designation: D394).

K
Adhesion test. No values are specified. However, the test is conducted according to "Tentative Method of Test for Adhesion of Vulcanized Rubber to Metal" (ASTM Designation: D429).

L
Moisture absorption test. Values are specified for Class TA. The test is conducted according to "Tentative Methods of Test for Changes in Properties of Rubber and Rubber-Like Materials in Liquids" (ASTM Designation: D471).

M
Inflammability test. No values are specified. As yet no standard method is available.

N
Repeated impact test. No values are specified. As yet no standard method is available.

P
Staining test. No values are specified. However, the test is conducted according to "Tentative Methods of Test for Contact and Migration Stain of Vulcanized Rubber in Contact with Organic Finishes" (ASTM Designation: D925).

R
Resilience test. Values are specified for Classes R and SC. The test is conducted according to "Tentative Methods of Test for Mechanical Properties of Elastomeric Vulcanizates under Compressive or Shear Strains by the Mechanical Oscillograph" (ASTM Designation: D945).

Z
Special tests. Any special characteristics of functional requirements, other than those prescribed by the other suffix letters, which may be desired for specific applications (for example, resistance to ozone or special fluids) shall be specified under Suffix Z.

The suffix requirements provide the consumer great versatility in describing the specific requirements for a given rubber product.

While standard numerical limits and test methods have not been established for all the requirements denoted by suffix letters, it is the Committee's intention to provide this information at the earliest opportunity. Further work of the Committee will be directed toward even greater simplification of the specification, which should result in making it even easier for the engineer to use.

It is recognized that these specifications are being used by industries other than the automotive industry. It must be remembered, however, that these specifications are subject to revision when required by automotive needs and there is no assurance that the changes will be acceptable to all other users.

Coordinating Research Council Financial Report

Below are given condensations of the balance sheet and operating statement of the Coordinating Research Council, Inc., of which the American Petroleum Institute and the Society of Automotive Engineers are the sustaining members:

Condensed Balance Sheet as of Dec. 31, 1952

Assets	
Cash	$ 32,453.69
Accounts Receivable	58,370.30
U. S. Bonds	31,040.00
Deferred Charges	9,817.17
Miscellaneous	425.00
Total	$132,106.16
Liabilities	
Accounts Payable	$ 13,787.29
Deferred Income	600.00
General Reserve	117,718.87
Total	$132,106.16

Operating Statement, Year Ending, Dec. 31, 1952

Income	
Contributions	
American Petroleum Institute	$ 30,000.00
Society of Automotive Engineers	30,000.00
Other	63,999.30
Army, Navy, Air Force Contracts	113,890.65
Miscellaneous	2,023.97
Total	$239,913.92
Expense	
Motor Fuels Division	$ 36,209.81
Aviation Projects	10,953.68
Diesel Projects	33,037.89
Lubricants Research	18,180.64
Army, Navy, Air Force	136,938.08
Total	$235,320.10
Operating Income less expense	$ 4,593.82

ISTC's Division VIII Continues to Study Ways to

ALLOYING elements for steels are still scarce, but automotive users are learning more and more about how to get along on a reduced alloy diet. These facts were borne out by reports on relative scarcity of elements and on alternate steels exchanged at the last meeting of Division VIII—Boron and Alternate Steels of the SAE Iron and Steel Technical Committee.

The 108 men present heard that the second quarter of 1953 may be worse than any preceding period for nickel. Reason is that the aircraft turbine engine program with its heavy requirements for stainless steels is getting into full swing. During the last quarter of 1952, average nickel content of stainless steel was running about 10.5% nickel because of production of very high nickel steels for jet engines and for the chemical industry.

Average nickel used in all types of nickel steels was 16.1 lb per ton during the first nine months of 1952, reported Dr. D. L. McBride of U. S. Steel. The goal now is to get the figure down to 8 lb of nickel per ton of nickel steel. Consumption at this rate would stretch the nickel enough to satisfy reasonable demands, even with the expected increase in total alloy steel used. To achieve the goal, users will have to go to non-nickel steels for some applications and to triple alloy steels in others. Triple alloy steels take only about 6 lb of nickel per ton of nickel steel, McBride pointed out.

Platers have pared their usage of nickel way down. Where before the shortage they used 50 million pounds annually, they now use only 8 million pounds.

Nickel users might as well consider most of their cut-backs permanent, it was emphasized. Even if controls go off steel, nickel will be restricted for years to come, predicted William Graze of the National Production Authority.

Other information on alloying element availability given to Division VIII was that:

- **Chromium** supply will not diminish further, NPA expects.
- **Cobalt** is still very scarce.
- **Tungsten** has been decontrolled.
- **Manganese** is plentiful, at present.

Boron steels and manganese steels are the bright spots in the alloy steels picture painted for Division VIII. Production of boron steels was running 70,000 tons per month at the end of 1952. That's just under 10% of total alloy steel production. Boron steel tonnage is split about evenly between heat-treating and carburizing grades. About one-third of the tonnage in heat-treating grades is in the 5XXX series. About three-quarters of the tonnage in the carburizing grades is in the 94XX series.

Boron steels are produced in these considerable tonnages because they are being used. And Dr. McBride, who was formerly with NPA in Washington, credited Division VIII with leadership in the boron steel movement. He said, "SAE can be justly proud of laying down the pattern for the use of boron steels and for the conservation of nickel and other critical alloying elements which other industries have been able to follow. It has been a big contribution to our national security all along the line. . . . The sun is beginning to rise so that in the case of a full emergency, we will be able to have the alloys necessary for both civilian and military uses."

McBride also urged Division VIII participants to investigate possibilities of manganese austenitic stainless steels as alternates to nickel austenitic steels. The manganese steels have favorable magnetic qualities. Their corrosion resistance is satisfactory in air and fresh water, but not in salt water. Manganese content is 16–17%.

Arthur F. Jones of the Watertown Arsenal told Division VIII that at least 90% of the Army's rolled armor up to 3-in. thickness is manganese-molybdenum-boron steel. One producer is using a Mn-Mo-B steel for cast armor.

Several papers and reports recently released on subjects of interest to Division VIII men were summarized at Division VIII's last meeting, December 3. They included:

"An End-Quench Test for Determining the Hardenability of Carburized Steels" by F. X. Kayser, R. F. Thomson, and A. L. Boegehold. Presented before the Metals Congress in Philadelphia, Oct. 21, 1952. Figs. 1, 2, and 3 are from this paper.

"The Endurance Limit of Temper-Brittle Steel" by R. D. Chapman and W. E. Jominy. Presented at the Metals Congress in Philadelphia, October, 1952. This is Paper No. 23 of the American Society for Metals.

"The Influence of Boron on Case Hardenability in Alloy Carburizing Steels" by E. S. Rowland and D. F. Jatozak. Presented at the Metals Congress in Philadelphia, October, 1952. This is Paper No. 14 of the American Society for Metals.

"Investigation of Significant Properties and Characteristics of Cold Worked Steel" by Metals Research Laboratory, Department of Metallurgical Engineering, Case Institute of Technology for the Office of Chief of Ordnance. This is in two parts: Research and Development Branch Reports No. 310/90-33 and No. 310/90-72.

These reports are summarized in the minutes of the December 3 meeting of Division VIII. The reports are not otherwise available through SAE.

1953 SAE Technical Board

Earle S. MacPherson, Chairman

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H. E. Churchill		W. M. Walworth

Surmount Alloy Shortages

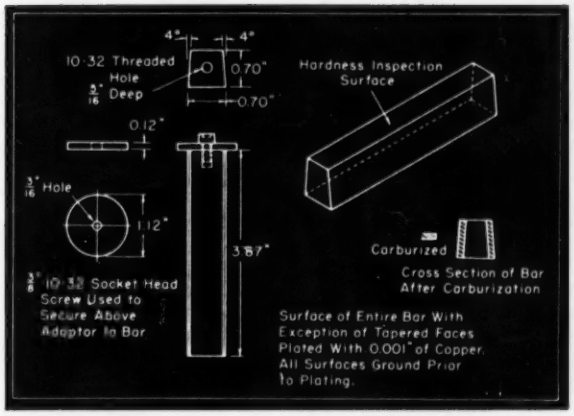


Fig. 1—Trapezoidal end-quench bar for measuring the hardenability of carburized steels, as described in paper summarized by Dr. R. F. Thomson of General Motors metallurgical department

The bar was machined 0.700 in. square in cross-section and copper plated. Two faces were then ground to 4-deg angles, removing the copper plate from these sides. As a result, only the two taper faces were carburized during the carburizing operation.

When the carburization operation was completed, the bar was end-quenched in the usual manner. The hardness impression surface was then prepared by removing the copper plate on a belt grinder and polishing. On this surface one can examine any point in the case or in the core, over the entire quenched length of the bar without the necessity of repeated grinding operations. Also, hardness impressions can be made on this surface in a direction essentially perpendicular to the carbon gradient.

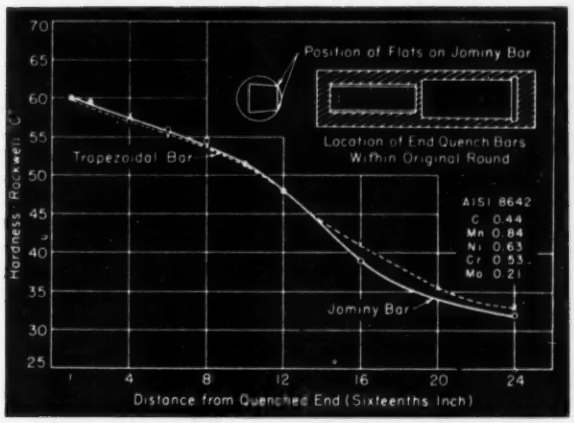


Fig. 2—A comparison of the hardenability of SAE 8642 as measured by the Jominy and trapezoidal bars

Experiments were conducted to obtain a comparison of cooling conditions in the trapezoidal and standard Jominy bars during end-quenching. Typical results are shown here.

To summarize the development work on the trapezoidal bar: (1) The bar has a hardness inspection surface providing access to any point in the case or core over the entire quenched length of the bar without repeated grinding operations. (2) The hardness inspection surface sections the case in such a manner that hardness impressions can be made essentially perpendicular to the concentration gradient. (3) The bar cools similarly to the Jominy bar during end-quenching and should yield equivalent hardenability measurements. (4) Each trapezoidal bar is essentially self-checking since two cases are available for inspection.

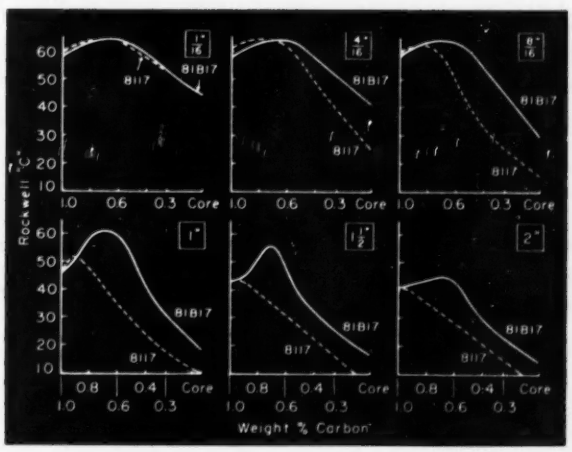
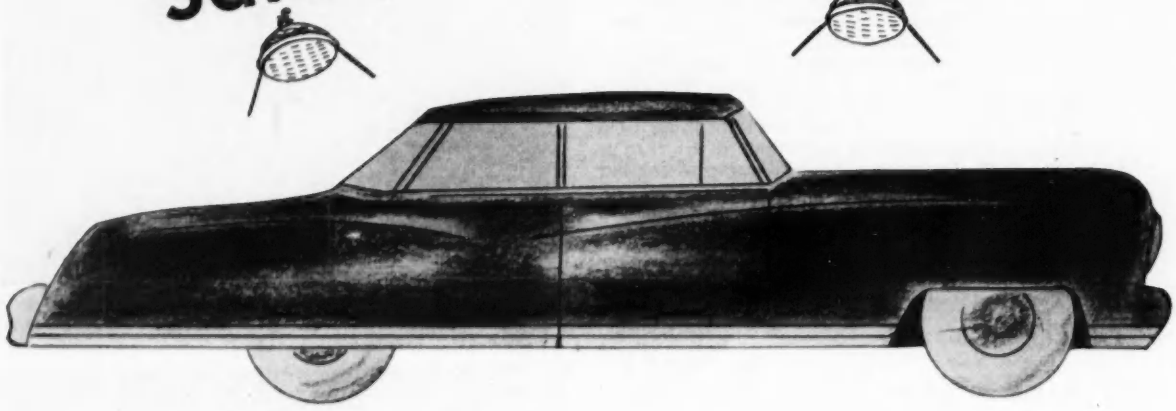


Fig. 3—Comparison of data on SAE 8117 and 81B17, showing the effect of boron on hardenability of a steel of this base analysis

At the 1/16-in. position, hardness is, of course, a straight function of carbon content. However, at the 4/16- and 8/16-in. positions, boron causes an increase in hardness of both core and lower carbon regions. Maximum effect of boron appears at about 0.70% carbon.

At 1% carbon, the two steels are of comparable hardenability. For the 81B17, hardenability decreases strikingly at carbon contents over about 0.70%. At this level hardness is the same from 1/16 to 1 in. As-quenched hardness at each individual carbon level shown above 0.70% remains essentially constant over the first ½ in. of the bar. However, these higher carbon regions show a drop at the 1-in. position. Therefore, case hardenability of 81B17 is less at these higher carbon levels than it is at about 0.70%.

Meeting Spotlights . . . Greater Safety More Comfort



PASSENGER-CAR manufacturers are trying to outdo each other—not in boosting speed—but in providing safety, comfort, and durability, it was shown at the SAE National Passenger Car, Body, and Materials Meeting, held March 3-5.

Purpose of increased horsepower is not speed, but greater agility at normal driving speeds for safety's sake. However, since increased horsepower can't help but make possible higher speeds, tires and brakes are being developed for 100-mph vehicles. And research is being done to determine what body shapes will be aerodynamically stable at that velocity, speakers revealed to nearly 800 engineers from car manufacturers and their suppliers gathered at the Sheraton-Cadillac in Detroit.

W. S. James pointed out in his paper (excerpts from which appear on pages 49 to 74 of this issue) that many of the highlights of this year's cars make driving easier and therefore safer. In this category he named power brakes, power steering, and automatic headlight dimmers. Such items leave the driver freer to devote his attention to the road, James noted.

As for comfort, several air conditioners now being offered in passenger cars do a good job of keeping passengers supplied with cool, clean air, designers—and customers who came forward during the discussion period—convinced their listeners. Now car manufacturers are striving to bring down costs so that more customers may enjoy the comfort of air conditioning.

In the interest of durability, researchers are developing better plating techniques to prevent corrosion, powdered-metal parts of controlled porosity, synthetic upholstery fabrics that will last the life of the car, and techniques for designing smoother-running valve gear—all of which were discussed at the meeting.

Speaking of tire safety at high speed, J. J. Robson of Firestone reported that getting rid of the traction wave is the big problem. This is a standing wave in the tire periphery which may extend half-way around the tire. Tire men think the explanation for it is, he said, that centrifugal force throws the tread just leaving the road aft, then the tread's spring effect pulls it in again. The tread oscillates back and forth noticeably for several cycles before damping out, building up unwanted heat in the tread.

Tire men have discovered how to construct tires that show very little traction wave at 100 or even 110 mph, Robson revealed. Besides changes in construction, the tires incorporate materials having improved heat resistance and bonding characteristics. And pressures are 4-6 psi higher.

Discussers confirmed the value of the increased inflation. Leo Gibbons presented a discussion by W. H. Elliott of B. F. Goodrich reporting that: (1) Tires initially inflated to different pressures build up to about the same pressure after operation at a given high speed. (2) The shorter the pressure build-up period, the better the tire withstands the heat. In tests, tires started at 24 psi and tires started at 30 psi were both at about 37 psi after 100 miles at 100 mph.

Deflection of the tires initially inflated to 30 psi was half that of tires inflated to 24 psi. Consequently, treads developed less heat and tires reached heat and pressure equilibriums sooner, Elliott reasoned.

Goodyear's Walter H. Shiveley also advocated higher pressures for high-speed operation. Why not

Longer Life

inject about 4 oz of water into the tire and take advantage of its added vapor pressure during fast runs, he proposed.

Robson and the discussers of his paper made it clear that they do not recommend high-speed driving. But they indicated that when production cars are capable of 100 mph they feel tires must also stand the speed. What's more, a tire that's safer at 100 mph is safer at normal speeds too, they pointed out.

For heavy, high-speed cars George Ladd and Sidney Dew suggested finned aluminum brake drums metallurgically bonded by the Al-Fin process to cast iron liners. Ladd, who presented the paper, is with the Al-Fin Division of Fairchild; Dew is with the British Al-Fin licensee, Wellworthy, Ltd.

Chief advantage of the aluminum-cast iron combination is the high heat conductivity of the aluminum coupled with the good wear of the cast iron. Other benefits are elimination of brake squeal and reduction in weight, Ladd and Dew brought out.

At the 1952 LeMans race, an 8.6 mile closed-course event, six out of the first 10 cars used Al-Fin bonded bimetallic brake drums, they noted. Racers have used aluminum fins on drums mounted in some cases

EXCHANGING dialect stories just before the dinner are Toastmaster V. A. Crosby (left), Speaker Dr. J. O. Christianson, and SAE President Robert Cass. At the dinner Crosby preached part of his famous "peesal tree" sermon in an exaggeration of his usual Mississippi drawl—then wound up by referring to the Northerners present as "rebels." Cass, a native of England, retorted "You're all rebels to me."

In a more serious vein during his dinner speech, Christianson told the 375 dinner guests that it's every American's duty in these times to strengthen the environment in which progress is possible. The help of all Americans is needed, he said, and we cannot afford to rule out anyone on the basis of color, religion, or national origin.

He urged each man present to take a little more care in his personal relations with other people and to assume a little more responsibility in his community. This way, every engineer can contribute to creating the environment for progress, which Christianson said is as important a job now as contributing directly to progress. It's up to the individual, he said, reminding his listeners that liberty comes from the governed, not the government—from the limitation of government, not its extension.

Christianson is superintendent of the University of Minnesota School of Agriculture and a consultant to General Motors Corp.

Around the Meeting . . .

After trying unsuccessfully to barter some of his jerked venison for a preprint, **Marcellus Merrill** (left) broke down and paid a quarter like every-

one else. Merrill gave his recipe anyway: slice venison tenderloin cross-grain, sprinkle on a little onion salt, dry the meat in the clear Colorado air, then smoke it.

Memories of sessions in the early '30s haunted the Tuesday evening session about "Wind Effects on Car Stability." Author **W. E.** (University of Michigan) **Lay** and Session Chairman **Frank Spring** both had been participants in sessions studying this same subject way back when "Teardrop" design was just beginning to be hotly debated. Lay's co-author **P. W. Lett** of Chrysler was probably looking forward to high school when those earlier sessions were arguing wind effects.

SAE Journal will carry abridgments of each paper presented at the Meeting. They will be accompanied by summaries of the impromptu discussion which followed the presentation, thanks to these note-taking session secretaries:

M. A. Forester, Packard Motor Car Co.
J. S. Laird, Ford Motor Co.
W. A. McConnell, Ford Motor Co.
R. F. Thomson, General Motors Corp.
Elwood Bolles, National Automotive Fibers
L. H. Nagler, Nash-Kelvinator Corp.
E. G. Moeller, Chrysler Corp.

Written discussions of the papers presented at the Meeting will be accepted at SAE headquarters until April 15. Three double-spaced copies will be appreciated.

Robert F. Kohr

Robert F. Kohr, meetings vice-chairman of the Passenger Car Activity, got together with a special subcommittee and drew up for the use of Sections a list of 16 paper suggestions in the passenger car field. The subcommittee included **J. B. Macauley, E. H. Smith,** and **James Booth. SAE President Cass** also sat in with them.

on the outer side of the wheel and in other cases on the inside. Ladd told a questioner that circumferential fins work well in the free air around outside-mounted drums. Drums inside the wheels, Ladd said, cool better with radial fins which can take advantage of the favorable pressure ratio across the wheel.

Besides having good tires and brakes, cars must be aerodynamically stable to be safe at high speeds, engineers at the Meeting recognized. This will require body design resulting in the center of pressure being close to the center of gravity, W. E. Lay of the University of Michigan and his former pupil, P. W. Lett, Jr., now of Chrysler, showed. Otherwise, sidewinds and gusts tend to cause excessive vehicle yawing.

This conclusion was one of those Lay and Lett drew from experiments in which they made a car body an independent unit and measured forces transmitted from body to chassis during highway tests.

Car Comfort

Most discussed comfort item at the Meeting was air conditioning. Participants in a three-paper symposium on the subject foresaw that demand for air-conditioning units will mount during the next 5 or 10 years to the point where one out of every 10 cars is equipped. This would require production of 500,000 or 600,000 units per year. Some engineers predicted mass production at this rate would bring prices considerably below the present $500-$600. Others were skeptical, pointing out that home window units of roughly equal capacity retail at about that price installed, despite high production rates.

P. J. Kent of Chrysler disclosed that his company's specifications for automobile air conditioning systems call for 1¼ tons of ice-melting capacity at 25 mph. This gives quick cool-down and adequate low-speed operation. About 25% of the air entering the evaporator is fresh, to dilute smoky air, Kent said.

Both the Chrysler system and the Frigidaire system, which was described in a paper by M. W. Baker and D. C. McCoy, drive the compressor off the engine and power the evaporator fan electrically. In the Frigidaire system, a metering solenoid valve offsets the variable speed of the compressor and its resulting variable capacity.

H. V. Joyce of Ford recommended that air conditioners be installed at the factory rather than by the dealer. He proposed that the engine mounts, tires, radiator, ducts, and other special parts for the air conditioning be installed on the final assembly line, and that the refrigerant be charged and tested in an off-line area.

Preventing Corrosion

Body engineers who flocked to sessions on prevention of corrosion were told that principal corrosive agents attacking car bodies are airborne combustion products in industrial areas, salt particles blown from the ocean or thrown up from de-iced streets, and nitric acid generated by lightning. Surprisingly enough, heavy rainfall and high humidity generally slow rather than accelerate corrosion of

steel, F. L. LaQue reported. Probably the water washes off the corrosive chemicals, he said.

Salt aggravates corrosion by interfering with the formation of protective rust films, according to LaQue. Salt incorporated in rust makes it hygroscopic, permitting corrosion to continue at lower humidity than it would otherwise.

Steels containing relatively high amounts of copper, phosphorous, chromium, or nickel offer 5 to 10 times the corrosion resistance of plain carbon steels, LaQue reported. He urged that body engineers consider use of more highly alloyed steels—and phosphate coating before painting. Designers should see that all surfaces drain readily and are able to dry quickly, he added.

Nickel plating is of course a good way to protect both steel parts and zinc die castings from corrosion—but to get the most good out of available nickel, the plating must be evenly distributed, D. M. Bigge of Chrysler warned. Otherwise, nickel build-ups are buffed off and wasted, and thinly plated areas corrode. Smooth forms without sharp depressions plate most uniformly, Bigge showed.

As with steel, protection given zinc-base die castings by nickel plating is proportional to plating thickness. A given thickness of nickel generally offers greater protection on zinc die castings than on aluminum or magnesium die castings. These facts were brought out by M. R. Caldwell and C. Pack of the Doehler-Jarvis Corp.

Other advantages they outlined to use of zinc die castings are:

1. Zinc die castings don't need to be polished or strapped before buffing as aluminum and magnesium die castings do.
2. Dies last longer with zinc.
3. Because aluminum and magnesium have to be cast at around 1200 F, their dies must be water cooled. Zinc melts at 750 F, and dies don't need water cooling.
4. Higher casting rates are possible with zinc. That's because temperatures are lower, there's less wear and tear, and lubrication isn't as critical.

Changes in base material costs could swing the balance in favor of aluminum or magnesium, though, Caldwell said. A discusser added that from the strategic viewpoint, magnesium has the advantage. We can always get our magnesium from the sea.

Corrosion resistance plus controlled porosity is being obtained in powdered metals parts, engineers learned from Gregory Comstock of Stevens Institute of Technology, who spoke of aircraft as well as ground-vehicle applications. He told of sweat-cooled turbine buckets fabricated with four different degrees of porosity.

First buckets made vapor locked because of inhomogeneities in the structure, Comstock explained. But spherical stainless steel particles solved that problem. They have also been found best for extrusion processes, in which the particles are squeezed out onto a slab or injected into a cavity, Comstock disclosed.

Longer-Lasting Upholstery

Nylon, orlon, dacron, and the other relatively new man-made fabrics for automobile interiors are just

. . . Around the Meeting

Two subgroups of the SAE Iron and Steel Technical Committee met during the Meeting. They were Division II—Ordnance Specification Review

(part of which is shown here) and the Steering Committee of Division VIII—Boron and Alternate Steels.

Gratitude of the Passenger Car, Body, and Materials Activities sponsoring the Meeting went to these eight men who served as chairmen of technical sessions:

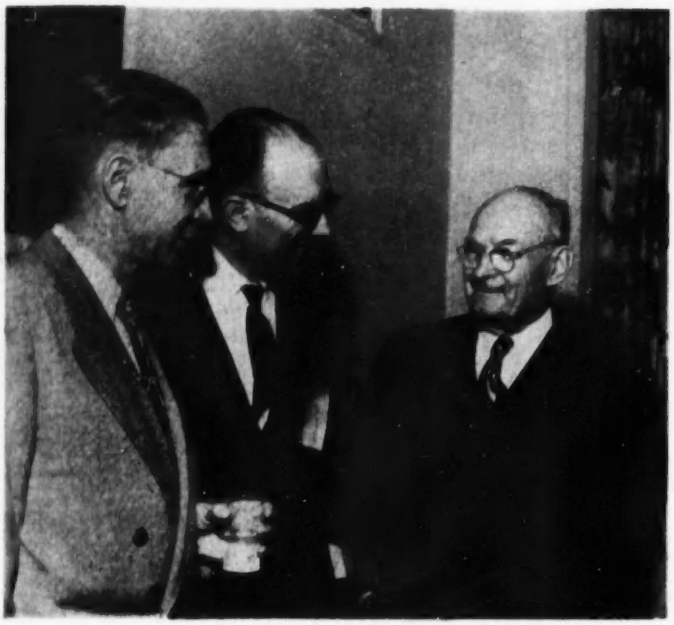
F. R. McFarland, Packard Motor Car Co.
J. L. McCloud, Ford Motor Co.
F. S. Spring, Hudson Motor Car Co.
A. L. Boegehold, General Motors Corp.
S. L. Terry, Chrysler Corp.
R. F. Kohr, Ford Motor Co.
E. H. Smith, Packard Motor Car Co.
M. M. Roensch, Ethyl Corp.

Detroit Section Chairman **Phillip Pretz** welcomed **Forrest McFarland**, chairman of the opening technical session to the platform, then conveyed greetings to all participants. Pretz was substituting for the Meeting's general chairman, **Edward Cole**, who was unable to be present.

Phillip Pretz and Forrest McFarland

Visitors at the Meeting included 10 members of the French Pressed Metal Industry Group led by **Jean Dubertret**, assistant general manager of Établissement Arbel. **Col. C. W. Kerwood** of the Mutual Security Administration and two interpreters from the French Embassy accompanied the group. The French delegation was welcomed by **SAE President Cass** on Tuesday morning.

Before the Dinner . . .



Prof. G. P. Brewington (left) of Lawrence Institute of Technology and B. E. Ricks of Thompson Products chat with Dean C. C. Winn of Detroit Institute of Technology

Ralph Teetor (left), president of Perfect Circle; David Wallace, president of Chrysler Sales Corp.; Bob Critchfield, general manager of Pontiac; and Tom Smith, president of Detroit Harvester pause for refreshment and conversation

Speakers table line-up halts just before entering Grand Ballroom for dinner climaxing the Meeting

E. L. Goad, executive vice-president of General Motors, greets H. D. Dawson, general manager of Delco-Remy

Rear Admiral Lloyd Harrison (left) is introduced by SAE Past-President R. J. S. Pigott to Charles Chayne, vice-president in charge of engineering for General Motors

forerunners of scores of even newer ones currently in the making. Biggest advantage is their durability, which is usually twice that of wool. But the older yarns, particularly cotton, will continue to have a place with the man-made fibers in combination weaves, according to W. F. Bird of Collins and Aikman and G. P. Carver, Jr. of Bachmann Uxbridge Worsted. The man-made fibers, these experts brought out in separate papers, are high in appearance, wear-resistance, public prestige and other favorable qualities . . . but also are high in price.

They have not yet brought a textile processing millenium, either. Theory might have pointed that way when presumably standardized fibers were substituted for variable natural ones. But, along with characteristics that make processing easier and cheaper, the new fibers have brought some new problems, such as those in the dyeing area.

Engineers from oil companies, wire manufacturing companies, and other varied industries vied with automobile body men in questioning the textile men. The questioners learned, among other things, that:

- There isn't much difference in strength, abrasive resistance, or cost between filament-type and spun-type yarns. . . . The filament type produces lustrous fabrics; the spun type softer fabrics.
- A pipe smoker shouldn't buy a dacron suit. A spark lighting on it will make a "melt" spot. But when cotton is woven with the dacron, the "melt" trouble will be much less.
- Man-made fibers are woven by the same methods as worsteds. They will not felt, so they can't be made as woolens.
- Fade-o-meters give very good correlation with actual exposure test results.

Valve Problems Discussed

Smooth-running, long-lasting valve gear are more difficult to achieve in overhead-valve engines than in L-head engines. That's because overhead-valve engines run at higher rpm's and their valve gear are heavier and more flexible. Some of the design problems involved and their solutions were outlined at the symposium on valve gear that constituted the final technical session of the Meeting.

Philip Barkan of The Pennsylvania State College and R. A. Roggenbuck of Ford each described an analytical method for calculating valve motion. Barkan set up his equations for solution on an International Business Machines Card Programmed Calculator. During the course of his mathematical reasoning, he even had to invent a new kind of friction, for which there is adequate evidence of physical counterpart, one of his colleagues affirmed during the discussion period.

Roggenbuck's differential equations were evaluated by analog methods at the Wayne University Computation Laboratory. Important conclusion reached from his study was that natural frequency of the valve train should be as high as possible.

Importance of high valve gear frequency—in the 40,000 to 50,000 cpm range—was confirmed by M. C. Turkish of Eaton Manufacturing. He discused the relationship of valve spring design to valve gear dynamics and hydraulic lifter pump-up.

Ralph P. Horan, also of Eaton, offered a solution for tappet misalignment—a tappet with hyperbolically contoured sides and flat face. The curved sides make the tappet self-aligning and the flat faces minimize face stresses. Horan cited a case where straight-sided tappets gave 100% failures, yet hyperbolic tappets ran indefinitely with exactly the same material combinations.

Hydraulic tappets require clean, air-free oil, Carl Voorhies of Chicago Screw emphasized. Best results come from excluding air, wherever possible, all the way from the oil sump to the tappets. He warned against using perforated oil pan baffles, oil pumps of insufficient capacity, castings with blowholes, and dead-end oil passages that can collect filings and dirt.

John A. Newton and M. J. Tauschek of Thompson Products labeled valve seat distortion the limiting factor in valve life, now that improved valve materials and valve rotators have solved other problems. The steps in correcting valve seat distortion include: opening up coolant passages in the critical area, resorting to faced and coated valves or sodium-cooled valves, and using a soft valve seat insert material. Most important in minimizing distortion is, however, the valve rotator, they said.

H. E. Chesebrough with **J. H. Booth**, and **G. C. Riegel.** Chesebrough is SAE vice-president representing the Body Activity. Booth is vice-president representing the Passenger Car Activity. Riegel is vice-president representing the Materials Activity. These were the three SAE Activities sponsoring the three-day Meeting.

SAE Men Star in Television and Radio

INTERVIEWS....

E. N. Cole (right), general chairman of the Meeting and chief engineer of Chevrolet, was interviewed for **WJR** by **Jack White,** the station's news editor, with **George Gaudaen** looking on. WJR carried the transcribed interview on its "News of Industry" program Saturday, March 7, at 7 p.m. Cole explained what SAE is and does —and reviewed news contained in some of the papers presented at the Meeting.

George Gaudaen represented the SAE Public Relations Committee as contact with the local press, radio, and television at this Meeting. His special activity in behalf of his fellow members resulted in, among other things, these three interview spots on local stations during the week.

W. S. James discussed highlights of the 1953 cars with **CKLW's Austin Grant.** James told radio listeners, as he told his SAE audience that evening, that trends in passenger cars are definitely toward special devices that will leave the driver freer to concentrate on the road

W. F. Bird, speaker at one of the Body Activity sessions, shows "Sallye" some of the fabrics he described to SAE. WWJ-TV televised the interview Tuesday afternoon as part of "Sallye's Program"

About

COL. WILLARD F. ROCKWELL, chairman of the board of the Timken-Detroit Axle Co., has been named director of productivity for the Mutual Security Administration. Rockwell has previously served the government as director of production for the U. S. Maritime Commission, a member of the executive committee of the Army and Navy Munitions Board and a member of the Requirements Committee of the War Production Board.

NEIL A. MOORE has been appointed executive vice-president of Copco Steel and Engineering Co., Detroit. Moore was 1946 SAE vice-president representing Production Activity.

DEL ROSKAM has been promoted to vice-president in charge of manufacturing of Cessna Aircraft Co., Wichita, Kans. Roskam was previously manufacturing manager, and prior to that served as director of purchasing and production manager. He has been with Cessna since 1942.

JOHN J. PHILLIPS has been named vice-president in charge of sales and engineering of Titeflex, Inc., Newark, N. J. Phillips joined Titeflex in 1940 and became chief engineer in 1949.

LAWRENCE A. HYLAND, since 1949 vice-president in charge of research for Bendix Aviation Corp., has been elected vice-president in charge of engineering. Hyland has been with Bendix since 1937. In 1950 he received the Navy's Distinguished Public Service Award for his "great service to science and to the welfare of the United States through his early contribution to the development of radar."

WALTER F. BENNING has been named general manager of the F. L. Jacobs Co., Detroit. Benning recently returned from Europe after completing a year as consultant to the Mutual Security Agency.

NICHOLAS W. ZELENEWYCH is now vice-president of the newly-formed firm of William Wyllie Clark, Inc., Albany, N. Y. He was previously supervisor for Albany Designing, Inc.

V. P. RUMELY has been elected senior vice-president, manufacturing, of the Crane Co., Chicago. Rumely was previously vice-president of manufacturing.

OSCAR E. EGGEN, vice-president of engineering of the Oliver Corp., Chicago, has resigned from the Oliver Corp. after 25 years with the company, in which he served successively as chief engineer, plant manager, director of engineering, and vice-president. He plans to vacation in California, and may make his home there. Eggen has been an SAE member since 1917.

MAURICE J. DAY has been promoted to assistant director for program development at Armour Research Foundation of Illinois Institute of Technology, Chicago. Day came to the Foundation in 1952 as manager of the materials and processes division after 15 years with the U. S. Steel Co.

THOMAS Z. FAGAN has been named director of sales and service for Scintilla Magneto Division of Bendix Aviation Corp., Sidney, N. Y. Fagan joined the Scintilla sales organization in 1922, and later served as sales manager. For the past several years he has been director of advertising and public relations.

THOMAS CARNEY has returned to the United States from Australia to become manager of engineering, foreign operations, for International Harvester Co., Chicago. Carney has been serving as manager of engineering for International Harvester Co. of Australia in Melbourne.

Members

LOUIS G. BURNS has joined Chandler-Evans Division of Niles-Bement-Pond Co., West Hartford, Conn., as chief pump engineer. Burns was previously with the Air Force's Air Research and Development Command at Wright Air Development Center, Dayton, Ohio. Before being recalled to the Air Force in 1951, Burns served as assistant chief engineer for Pesco Products and director of engineering for Aero Supply Mfg. Co.

COM. H. J. HUESTER, who was previously stationed at the Aviation Supply Office in Philadelphia, is now with the overhaul and repair department of the Naval Air Station at Jacksonville, Fla.

H. D. LOWERY has been named plant engineer at the Chrysler Delaware Tank Plant. He was previously assistant plant engineer, and before that served on the staff of the general manager of Chrysler's Jefferson Plant. He has been with Chrysler Corp. since 1949.

RICHARD H. LeTOURNEAU, who was formerly general manager of the Mississippi Division of R. G. LeTourneau, Inc., in Vicksburg, Miss., is now general manager of the Longview, Texas, plant.

H. G. WARNER, who has been general superintendent at the Cleveland Tank Plant of GMC's Cadillac Motor Car Division, is now in Detroit as superintendent of methods and equipment for Cadillac.

R. J. S. PIGOTT is now in Europe on a brief visit. He will address the Societe des Ingenieurs Civils de France in Paris, the Societe Royale Belge des Ingenieurs et des Industriels in Brussels, and the Oil Industries Group in London. While in Paris, Past-President Pigott will also visit the Societe des Ingenieurs de l'Automobile to extend greetings from SAE.

RICHARD C. KORFF has joined Hotpoint, Inc., Chicago, Ill., as process engineer. Korff was formerly sales and service engineer for Ashdee Products, Inc., Homewood, Ill.

SAMUEL J. EVISON has been named assistant vice-president of the Hupp Corp., Detroit. He was formerly head of sales engineering for the Electric Auto-Lite Co., Toledo, Ohio.

STANFORD LANDELL has been named director of the product engineering and sales departments of Brown-Lipe-Chapin Division of GMC, Syracuse, N. Y. Landell was previously body engineer for Oldsmobile Division in Detroit.

WILLIAM E. McCOMAS is now chairman of the change control board at Hughes Aircraft Co., Culver City, Calif. McComas was formerly with Pan American World Airways in San Francisco as special assistant, operations.

JOHN K. NORTHROP is now consultant to the president of the Garrett Corp., Los Angeles, Calif., and will make a military product survey for AiResearch Mfg. Co., a division of Garrett. Last November Northrop retired from the presidency of Northrop Aircraft, Inc., because of ill health. Though his health has greatly improved, he will work for Garrett on a part time basis.

LEWIS K. MARSHALL is now manager of the aircraft turbine plant of Ford's Lincoln-Mercury Division, Detroit. He was previously field relations representative for Lincoln-Mercury.

RICHARD K. McCONKEY has been appointed assistant general manager of the industrial division of Timken Roller Bearing Co., Canton, Ohio. He was previously district manager for the industrial division at Timken's office in Moline, Ill., and has been with the company since graduating from Northwestern University in 1935. McConkey is currently chairman of SAE's Milwaukee Section.

H. J. BUTTNER is executive assistant at Continental Aviation and Engineering Corp., Detroit. He has not, as erroneously reported in the February Journal, returned to Purdue University. Buttner left his post at Purdue in February, 1952, and for eight months was chief production engineer for A. V. Roe Canada, Ltd., before joining Continental Aviation and Engineering.

CORRECTION

ROBERT K. JACK has retired as chief engineer of Divco Corp., Detroit. Jack has been chief engineer of Divco since 1946, and prior to that was chief engineer of Reo Motors, Inc. He has spent more than 50 years in the automotive industry since he became an apprentice at Argyll Motors, Ltd., Glasgow, Scotland, in 1902. He and Mrs. Jack are now in Daytona Beach, Fla.

CHARLES S. DOERR has been appointed secretary and executive officer of the Engineers' Club of Philadelphia. He was previously chief consulting engineer of the General Stores Supply Office of the Department of the Navy in Philadelphia. During World War II he served in Washington in various governmental capacities. He has been an active member of the Engineers' Club for 20 years, and is currently a director and junior adviser.

ALLAN G. HASKELL has retired from Champion Spark Plug Co., Toledo, after 36 years with the company. For many years he has been district manager of Champion's equipment sales in the New York area. A graduate of Yale, Haskell served with General Electric Co. and the Gray and Davis Co. before joining Champion. He has been an SAE member since 1917.

DONALD F. PENNELL has been named chief of wholesale sales of Kenworth Motor Truck Corp., Seattle, Wash. Pennell joined Kenworth in 1936, leaving to serve with the Army Transportation Corps in the Pacific from 1943 to 1946. He returned to Kenworth as project engineer and has made a number of field trips in this assignment, including work in Arabia. Pennell is field editor of Northwest Section.

FRANK W. FINK, chief engineer of Consolidated Vultee Aircraft's San Diego division, is currently serving as acting works manager of the company's Plant I in San Diego. The temporary assignment, made to give Fink experience in directing manufacturing operations, is part of Convair's executive development program.

W. RAYMOND MYERS has been named assistant manager of original equipment sales for the metal products division of the Goodyear Tire and Rubber Co. He joined Goodyear as a sales engineer in the rim division in 1946.

GERALD E. BICKFORD is now with the ordnance division of Chrysler Corp., Highland Park, Mich., as a layout man. He was formerly with Holley Carburetor Co. in Detroit.

ERNST A. LONGNECKER is now president of the Yard Man Co., Jackson, Mich. Longnecker was previously president of the Lauson Co., New Holstein, Wis., and the Le Roi Co., Milwaukee, and was more recently associated with the Jacobsen Mfg. Co., Racine, Wis.

DONALD K. MARSH is now assistant manager of the aircraft division of General Controls Co. in Skokie, Ill. He was formerly with Teleflex, Inc., North Wales, Pa.

DR. GUSTAV EGLOFF, director of research for Universal Oil Products, Des Plaines, Ill., received the Washington Award for 1953 in a ceremony Feb. 23 in Chicago. The award, conferred by five engineering societies, cited Dr. Egloff's "distinguished leadership in petroleum research and development in professional activities and in community services." Dr. Egloff is a past president of the Western Society of Engineers, the American Institute of Chemists, and the Chicago Technical Council.

HYMAN BORNSTEIN has retired as chief technical consultant to Deere and Co., Moline, Ill. He is now a consulting metallurgist 2500 Eleventh St., Moline, Ill.

A. J. UNETIC, who was formerly manager of laboratories for Jack and Heintz, Inc., Cleveland, is now chief engineer for Kwikset Locks, Inc., in Anaheim, Calif.

D. B. DICKERSON, JR., has joined the mechanical design department of P. R. Mallory Co., Inc., Indianapolis, Ind. He was previously contact and service manager of Dickerson Engineering Co., Detroit.

CONRAD R. HILPERT is now in charge of the experimental department of the Twin Disc Clutch Co., Rockford, Ill. Hilpert was formerly with International Harvester Co., Melrose Park, Ill., as test engineer with the industrial power division.

GEORGE W. DORR has joined the Engineering and Research Corp., Riverdale, Md., as development engineer for the company's armament section. He was formerly weapons system officer for the Air Force's Air Research and Development Command at Wright Air Development Center, Dayton, Ohio.

CLAUDIO C. REVIGLIO has returned to his post as manager of the technical department, automotive division, for Socony Vacuum Italiana in Genoa, Italy, after spending some months in the United States in the latter part of 1952. Before being appointed technical manager early last year, Reviglio was chief engineer for Socony Vacuum in Turin.

RANDALL W. RICHARDS, JR., is now regional manager for Pennsylvania of Reo Truck Leasing, Inc., new subsidiary of Reo Motors. Richards, who will make his headquarters in Philadelphia, was previously branch manager for Universal Motor Mileage in Los Angeles, Calif.

RICHARD E. REITER has been named superintendent of the land gear division of Willys-Overland Motors, Inc., Toledo, Ohio. He was previously general manager of the Leading Engine Co., Farmington, Mich.

CHARLES M. KEEPERS has joined the RCA Estate Appliance Corp., a subsidiary of Radio Corp. of America, Cincinnati, as director of quality control. Keepers was formerly works manager in Cincinnati for the Wayne Pump Co.

RICHARD F. EBERLINE is now general manager of the Syncro Corp., Oxford, Mich. Eberline was previously vice-president in charge of sales of the C. M. Hall Lamp Co., Detroit.

W. O. SWEENY is now assistant vice-president of the Arwood Precision Casting Corp., New York City. He was previously development manager of precision castings for Haynes Stellite Co., Kokomo, Ind.

J. T. ELLIOT, JR., is now vice-president and general manager of Hawaiian Motors, Ltd., Honolulu, T. H. He was previously vice-president of Honolulu Motors, Ltd.

OLAF SAARINEN has been named assistant head of the department of technical information at Chrysler Corp.'s missile branch, Detroit. He was previously technical specialist with Chrysler's engineering division.

DONALD E. KIEFERT has joined the Investment Casting Division of Howard Foundry Co., Milwaukee, Wis., as assistant chief engineer. Kiefert was formerly assistant engineer with the tractor engineering department of Allis-Chalmers Mfg. Co. in Milwaukee.

BERNARD W. WORTELBOER has been named assistant chief engineer at the Kendallville, Ind., plant of Universal Friction Materials Co. In addition to assisting chief engineer **A. C. TEETSEL**, he will supervise the chemical laboratory. For the past five years, Wortelboer has been with American Brakeblok Division of American Brake Shoe Co., Detroit, as research and development engineer and chemist in the friction material division.

Goodyear Changes

Lee

Lafaye

WALTER J. LEE has been appointed manager of tire development and compounding at Goodyear Tire and Rubber Co., succeeding **WALTER W. VOGT**, who has asked to leave that post for reasons of health. Vogt will take on special technical duties as assistant to Goodyear Vice-President **R. P. DINSMORE.**

Lee was previously general manager of Goodyear's rim division in Detroit. He was chairman of the membership committee of SAE's Detroit Section from 1949 to 1952.

HILTON J. LAFAYE will succeed Lee as general manager of the company's metal products division, previously the rim division. Lafaye joined the division as a salesman, and was named sales manager in 1951.

Charles Faroux named to Legion of Honor

CHARLES FAROUX, French automotive pioneer, who recently celebrated his 80th birthday (right), received the Cravate de Commandeur de la Legion d'Honneur, highest French decoration, at a ceremony March 26 in Paris. Faroux is founder of the famous 24 hours race of Le Mans, and of the International Automotive Institution. A frequent visitor to the United States, he has been a consultant to the late Henry Ford . . . and earlier, around the turn of the century, worked for a while on "les tramways de Milwaukee." He is editor of "La Vie Automobile."

SAE Members Are Saying . . .

"We businessmen constantly applaud competition and private enterprise, and damn socialism and planned economies. We accuse our foreign neighbors of lacking the kind of spirit which has made American industry great. We implore them to follow our example and get off our backs. So I just say, let's practice what we preach, where it will do us and our allies some real good. Let's give our friends a fair crack at the American market . . . I believe we ought to get rid of the 10% tariff on automobiles at once." . . . **Henry Ford II**, president, Ford Motor Co., before the Inland Daily Press Association.

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"The American way to increased productivity through improved machines is the way to meet the expanding requirements of a rapidly increasing national population. Each year it is going up by about two and one quarter million persons, and that's like adding a state each year with the population of Iowa." . . . **L. L. Colbert**, president, Chrysler Corp., in address at the Economic Club of Detroit.

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"One of the most spectacular petrochemicals is the insecticide aldrin, which is effective against devastating pests such as locusts, boll weevils, and grasshoppers. During 1951, Iran had its worst locust plague and called on the United States for help. A team flew over from this country with supplies of aldrin and in four days time, the locust kill was 100% and over 53,000 acres of crops were thereby saved." . . . **Dr. Gustav Egloff**, director of research, Universal Oil Products Co., in accepting the Washington Award of the Western Society of Engineers.

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"The more you work with people, the more you become convinced of the importance and the difficulty they have in setting down a well defined goal. Most people make a determined effort to be vague. Instead of saying I'm worth $6,000 a year, they purposefully avoid admitting it to themselves with the hope that someone will offer them $25,000. They are equally vague about their job. They won't say 'I want to be an Office Manager' because they hope someone will offer them the Presidency." . . . **John C. Hollis**, director of SAE's Placement Service, in a talk to the Advertising and Selling Course.

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"I think it is fair to say that the cars aren't going to get any bigger. . . . We now have cars with an overall length that takes up most of the garages in use, and I don't see that even our biggest cars can get much longer." . . . **William Graves**, vice-president, engineering, Packard Motor Car Co., in February issue of Popular Mechanics.

H. C. SCHULTZ has been named sales manager for the Diamond T Truck Co. in Los Angeles, Calif. Schultz was previously vice-president and branch manager in Los Angeles for the Sterling Division of White Motor Co.

JOHN C. HOLLIS, director of the Placement Service at SAE Headquarters, presented a talk to the Advertising and Selling Course on March 5 in New York City on "How To Get Ahead in Advertising and Selling."

RALPH L. SKINNER, JR., is now manager and partner of the Flexible Seal Co., Detroit. He was previously sales engineer for the Fulton Sylphon Division of Robertshaw-Fulton Controls Co., in Detroit.

ROBERT S. SEIDEL has joined the Chicago Telephone Supply Corp., Elkhart, Ind., as production engineer. Seidel was formerly junior engineer for Eclipse Machine Division of Bendix Aviation Corp.

JOHN H. VANDERBILT has been promoted to test equipment engineer for the test department of Wright Aeronautical Corp., Wood-Ridge, N. J. Vanderbilt was previously tool designer for Wright.

OLIVER E. RODGERS is now chief engineer of the aircraft division of Packard Motor Car Co., Detroit. He was previously assistant manager of engineering for Westinghouse Electric Corp. in Essington, Pa.

GEORGE W. McGOWN has joined the Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp., in Oak Ridge, Tenn., as junior engineer. He was formerly a designer for the Heald Machine Co., Worcester, Mass.

FLOYD WATERS, JR., has joined GMC's Allison Division, Indianapolis, Ind., as detail engineer on experimental aircraft engine testing. Waters was previously draftsman for Reo Motors, Inc., Lansing, Mich.

ROSS A. MCFARLAND, associate professor of industrial hygiene at the Harvard School of Public Health, is the author of a new book entitled, "Human Factors in Air Transportation —Occupational Health and Safety." This volume is an outgrowth of the author's interest in aviation and industrial medicine for the past 20 years. It covers such problems as selection, training, and health of flight and ground personnel, safety on the ground and in flight, sanitation and health in airline operations, passenger and service problems, health and medical services in air transportation. It contains 830 pp. and 151 illustrations. Publisher is McGraw-Hill. Price is $13.

Eaton Pump Division Promotes Three

W. ROSS EAMES has been promoted to assistant to the general manager of the pump division of Eaton Mfg. Co., Detroit. He will continue to serve as chief engineer of the division, the post he has held since 1949. **LOUIS A. SELIN** has been appointed assistant sales manager. Selin has been with Eaton's pump division since 1943, serving as a member of the planning department, quality representative, and sales representative. **NICHOLAS A. NOREYKO**, who was previously drafting room supervisor, becomes assistant chief engineer. He joined the pump division as a draftsman in 1941.

Eames

Selin

Noreyko

HERBERT K. SACHS has joined GMC's Truck and Coach Division, Pontiac, Mich., as senior designer. He was formerly design analyst with International Harvester Co. in Fort Wayne, Ind.

ALFRED E. GRATER has retired from the Clark Equipment Co., Jackson, Mich., where he was field engineer. He now lives in Shipshewana, Ind.

MALVERN S. BAKER, who was previously project engineer with Spicer Mfg. Division of the Dana Corp., Toledo, Ohio, is now executive engineer of the American Tractor Corp., Churubusco, Ind.

JAMES E. GORDON is now with the Reader's Digest Association (Canada), Ltd., Toronto, Ont. Gordon was previously account executive for Time, Inc., in Toronto.

MARSHALL SITTIG has been transferred from Ethyl Corp.'s research laboratories in Detroit to Ethyl's New York City office. Before joining the corporation a year ago, Sittig was with the engineering division of Chrysler Corp.

PHILIP E. CHASE is now chief mechanic on Wake Island for Pan American World Airways.

HARRY B. KNOWLTON, chief engineer of materials engineering, International Harvester Co., leaves April 10 for a one-month trip through France, Germany, Italy, Belgium, Netherlands, and Great Britain. He will be one of a two-man Mutual Security Administration team to exchange information on boron steel and other metallurgical subjects with European engineers.

R. H. HALES has joined the Engineering Journal, published weekly in London, as assistant editor. Hales was formerly assistant to the chief draftsman at Coulter Copper and Brass Co., Ltd.

CHARLES W. FRICK is now vice-president, sales and engineering, of the Dolphyn Engineering Co., Detroit. He was formerly master mechanic for Kaiser-Frazer Corp., Dowagiac, Mich.

C. O. BURGESS, technical director of the Gray Iron Founders' Society, recently made a three-week visit to Europe to study research methods in Great Britain, France and Switzerland.

OTTO LESSING is now resident engineer for Aramco Overseas Co., a division of Arabian American Oil Co., in Rome, Italy. He was previously assistant district manager for Arabian America in Dhahran, Saudi Arabia.

H. J. HOWERTH, JR., has been named assistant sales manager of the Wayne, Mich., division of Gar Wood Industries, Inc. Howerth has just returned from a year in Korea, where he served as a captain with the Army Ordnance Corps. Before being recalled to the Army two years ago, he was chief sales engineer for the Wayne division.

ALFRED P. NELSEN is now a partner in the H. M. Dingley Co., Seattle, Wash. He was previously manager of the automotive parts division at the Seattle branch of Wagner Electric Corp. Nelsen is chairman of SAE's Northwest Section.

WALTER M. WALDBAUER has been named field engineer for the Lord Mfg. Co. in Cleveland, Ohio. He was previously project engineer for Lord in Erie, Pa.

SAE Father and Son

Newest SAE father and son team is **WILLIAM S. FLOGAUS** (left), test engineer for the Aviation Gas Turbine Division of Westinghouse Electric Corp., Lester, Pa.; and **HOWARD A. FLOGAUS**, (right), president and owner of Craft-Hollow Industries, Wallingford, Pa. William Flogaus has been an SAE junior member for about two months, was previously an enrolled student member. Howard Flogaus has been a member since 1918, and was Vice-President representing Truck and Bus Activity in 1945.

OWEN W. HALE has joined Industrial and Foundry, Sales, Inc., Eaton Rapids, Mich., as general sales engineer. Hale was formerly sales engineer for the Anderson Co., Detroit.

HAROLD G. B. PERRY is now consultant for the Societe Foster Wheeler Francaise in Paris. Perry was formerly operations and maintenance engineer in Casablanca, French Morocco, for Fay, Spofford and Thorndike of Boston, Mass.

HARRY LOUIS is now engineering superintendent of Fleet Mfg., Ltd., in Dorval, P. Q. He was formerly engineering and maintenance manager for Queen Charlotte Airlines, Vancouver, B. C.

LEWIS C. LADERER has been named sales manager of the Wells Specialty Co., Inc., North Liberty, Ind. He was formerly with the Aluminum Co. of America in South Bend, Ind., as sales engineer.

WATT L. MORELAND (left) was honored as "Mr. Truck of California" at the California Motor Transport Association's recent annual convention in Coronado, Calif., and was presented with a silver tray by Neil J. Curry, chairman of the convention. The occasion marked a half-century since Moreland built the Tourist motor delivery wagon, reputedly the first truck built in California.

EDWARD J. WELLER is now mechanical engineer for Goodyear Tire and Rubber Co. in Gadsden, Ala. Weller has recently been working on expansion of Goodyear's plant in Topeka, Kans., and will do similar work in Gadsden.

F. SCHNACKENBERG has been promoted to manager of the Busch-Sulzer Division of Nordberg Mfg. Co., St. Louis, Mo. He was formerly machine shop superintendent for Nordberg in Milwaukee.

STANLEY J. GARNER is now process engineer for Lincoln-Mercury Division of Ford Motor Co. in Detroit. He was previously with the Fitzgibbons Boiler Co., Oswego, N. Y., as a tool engineer.

ERNEST N. PEARSON has joined Pratt and Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., as analytical engineer. He was previously with the turbojet projects branch of Aro, Inc., Tullahoma, Tenn.

ERNEST V. SMUTEK has joined the Anderson Co., Detroit, as sales engineer. He was previously sales engineer for the Hupp Corp.

WILLIAM J. REID is now export salesman for ESB International Corp., New York City, a subsidiary of the Electric Storage Battery Co. Reid was formerly district sales representative for the Willard Storage Battery Co. in New York.

NEWS OF SAE

pages 95—103

PRODUCTION . . .

. . . Tomorrow issue of SAE Journal next month to highlight design-production relationships.

THE May issue of the SAE Journal will forecast the manufacturing advances of the future growing out of developments of today. This special "Production Tomorrow" issue is the first of its kind ever published by the Society and will emphasize related problems of design and productive interests.

The feature section of the May Journal will lead off with a penetrating analysis of what's coming over the production horizon in the next 10 years. Emil Gibian of Thompson Products will describe trends in manufacturing methods, machines, and management operations. The feature articles in this issue also will include:

• **The Automatic Factory**, by D. S. Harder and D. J. Davis, Ford Motor Co. . . . to emphasize the thinking that goes into automation and the changes it brings in manufacturing operations.

• **Operations Research**, by John B. Lathrop, Arthur D. Little, Inc. . . . a new decision-making tool for production men and engineers.

• **Hot and Cold Extrusions**, by J. H. Friedman, National Machinery Co. . . . how slow, tricky processes of the past are giving way to faster, more economical methods.

• **Ford Engine Plant and Foundry** . . . a picture trip through one of the most modern engine-building facilities.

• **Unusual Problems in Machining Automatic Transmission Parts**, by H. H. Whittingham, Borg-Warner . . . will tell about improvisation in processes, tooling, and machinery to fabricate these parts.

• **Reinforced Plastic Car Bodies** . . . by three authors who report unusual features of these materials, what is needed to adapt them to automotive mass production.

• **Giant Forging and Extrusion Presses** . . . a progress report on the new challenge to aircraft design engineers and production men brought by large forgings and extrusions.

• **Cadillac Tank Plant** . . . how unusual materials handling devices lift and move tank components.

• **The Future of Atomic Energy in Industry**, by Walker Cisler, Detroit-Edison Co. . . . government policy and technical limitations are holding up nuclear power for generation of electricity.

• **Where Do We Stand on Titanium?** . . . the answer to this one will come from a sextet of specialists on the metal's behavior, applications, and potentials.

• **Production Meeting Report** . . . an on-the-spot coverage of highlights at the SAE National Production Meeting in Cleveland last month.

The "Production Tomorrow" issue of the SAE Journal is an outgrowth of the Society's expansion in the production area. The increased number of meetings programs planned and sponsored by the SAE Production Activity Committee is producing more information and material on manufacturing and processing for publication. It's also bringing greater participation from production-minded SAE members.

Ride and Vibration . . .

. . . instrumentation users and makers to parade woes and wares at Summer Meeting round table.

EVERY U. S. passenger-car manufacturer goes all out to get the utmost in vehicle riding comfort. The motivation is there then. But sometimes the tools are not. Before some objectionable vibration can be eliminated, instrumentation is invariably needed both to measure it and to locate its source. Suitable instrumentation may or may not be available.

But this comes as news to no one. The big news is that there's going to be a get-acquainted-with-instrumentation round table at the Summer Meeting. Ride and vibration engineers will get a chance to let their hair down. Instrument manufacturers will get a chance to strut their stuff.

On the one hand, automotive research engineers will be able to enlighten instrument manufacturers on their unfilled needs. Instrument makers, on the other hand, will be given an opportunity to describe the operation, advantages and uses for their

latest ride and vibration recording devices.

But that's not all! Both of these groups will get a chance to:

• Find out what instrumentation the SAE Riding Comfort Research Committee suggests for various ride and vibration measurements.

• Express their comments on this proposed recommended practice.

Ford's Arthur Bodeau, who is chairman of the Riding Comfort Research's Subsommittee on Instrumentation, is working out the details for this Passenger-Car Activity sponsored round table.

APPROVED . . .

. . . for publication in full in 1953 Transactions are 46 papers so far.

ALREADY approved for publication in the 1953 SAE Transactions are the 46 papers listed below. This now-annual bound volume will be ready for distribution in September. It will contain between 700 and 800 pages.

Growth and Status of Highway Transport
by B. B. Bachman

New Test for Drawability of Sheet Steel
by C. B. Buker and J. R. Speer

Engine-Transmission Relationship for Higher Efficiency
by D. F. Caris and R. A. Richardson

Some Factors Affecting Precombustion Reactions in Engines
by M. W. Corzilius, D. R. Diggs, and D. L. Pastell.

Effect of Combustion Time on Knock in Spark-Ignition Engine
by D. R. Diggs

Wear Prevention by Alkaline Lubricating Oils
by J. C. Ellis and J. A. Edgar

Temperature Gradients and Heat Stresses in Brake Drums
by G. A. G. Fazekas

Combustion-Chamber Deposition and Knock
by H. J. Gibson, C. A. Hall, and D. A. Hirschler

Hydraulic Torque Converter—Common-Law Spouse of Heavy-Duty Truck
by W. B. Gibson

Engines to Digest the Vitamin-Enriched Fuel—Elpeegee
by J. E. Glidewell

Spark-Plug Fouling Studies
by R. J. Greenshields

Rolling Wheels Gather No Skids
by A. C. Gunsaulus

Coating Steel by Aldip Process
by D. K. Hanink and A. L. Boegehold

Steering of Track-Type Vehicles
by W. W. Henning

Fast Replacement or Heavy Maintenance
by C. C. Hudson

Laboratory and Field Wear Tests Using Radioactive Tracers
by H. R. Jackson

Stress Testing Methods in Body Structures
by H. C. Johnson

Supercharged Diesel Performance versus Intake and Exhaust Conditions
by L. Johnson

Effect of Aerodynamic Heating on Fuel Systems
by J. Jonas

Engine Wear—Comparison of Radioactive Wear and Field Measurements
by F. W. Kavanagh

New Look at Scoring Phenomena of Gears
by B. W. Kelley

Afterburners and Variable Nozzles
by R. Kress

Lubricants—Surface Savers
by J. F. Kunc, Jr. and J. P. Hamer

How Engines Wear
by J. F. Kunc, Jr., D. S. McArthur, and L. E. Moody

New Technique for Investigating Jet Engine Compressor Stall and Other Transient Characteristics
by W. J. Kunz, Jr.

New Buick V-8 Engine
by V. P. Mathews and J. D. Turlay

Engine-Cylinder Pressure Measurements
by J. D. McCullough

Wear Measurements by Physical, Chemical, or Radioactivity Methods
by C. C. Moore and W. L. Kent

Considerations for Commercial Valve Maintenance
by J. A. Newton and N. Hoertz

Today's Aluminum Aircraft Alloys
by J. A. Nock, Jr.

European Postwar Cars
by M. Olley

Effect of Heavy-Duty Oils on Engine Wear in Typical Passenger-Car Service
by J. L. Palmer

Can the Airlines Use the Helicopter?
by F. N. Piasecki and L. S. Wigdortchik

Can All Engine Wear Be Trapped in a Can?
by R. J. Pocock

Fleet Management: A Job Evaluation
by T. L. Preble

Critical Lubrication Areas in an Engine
by V. G. Raviolo

Survey of Combustion-Chamber Envelope
by C. G. A. Rosen

What's Ahead in Commercial Vehicle Powerplants
by C. G. A. Rosen

Hydraulic Torque Converter—Its Effect on Power Train
by R. M. Schaefer and J. A. Winter

Plastic Prototypes Revolutionize Preparation for Manufacture
by W. A. Stanley

Mode of Formation of Lead Deposits in Gasoline Engines
by J. C. Street

Construction and Operation of Brake Testing Dynamometers
by SAE Brake Subcommittee 3

Automobile Batteries—Selection, Service Life, and New Developments
by L. E. Wells

Method for Identifying Preignition
by R. F. Winch and F. M. Mayes

Contemporary European Aircooled Diesel-Engine Practice
by W. H. Worthington

Engineering Possibilities of Synthetic Lubricants
by W. A. Zisman

SEMINARS . . .

. . . on materials and processing go over big as SAE meetings in Southern California Section.

FAST-MOVING progress in aircraft materials and processes keeps engineers hopping to stay abreast with latest developments in the field. The SAE Southern California Section has come up with a series of seminars that goes a long way toward doing this for these engineers. The first three seminars on titanium, adhesives and sealants, and ultra high-strength steels proved exceptionally popular, judging by the turnout.

Each seminar consists of three or four separate sessions designed to cover:

1. A general picture of properties and availability of the material as well as information on applications and cost.

2. Information the design engineer wants to know about the material. . . physical and mechanical properties, performance in various applications, and resistance to deterioration.

3. What the materials and processing engineer wants to know. . . behavior of the material in fabrication and processing, such as machining, forming, bending, heat-treating, and plating.

At each session one or more outstanding specialists on the subject present a talk. This is followed by an intensive discussion period.

Apparently this meeting method is a palatable way of disseminating much-needed information. It attracts the customers, reports L. P. Spalding, seminar chairman.

The first seminar, on titanium, in September of last year, drew more than 500 at three sessions. The main speaker on this program was Dr. W. L. Finlay, Rem-Cru Titanium, Inc. Ten specialists from local aircraft companies served on a panel that participated in the discussion.

The four-session seminar on adhesives and sealants last January attracted more than 300 men. At the first session, Dr. N. A. deBruyne, of Aero Research, Ltd., discussed the theory of adhesion. Rubber-like adhesives and sealants were described at the second session by Dr. W. J. Clayton, of Minnesota Mining & Mfg. Co. The third session was devoted to phenolic base adhesives which were discussed by E. P. Carmichael and Dr. W. F. Gross, of Narmco, Inc. A fourth session on epoxy-base adhesives, described by Dr. D. W. Elam, rounded out the seminar.

Last month the Southern California Section held its third seminar on ultra high-strength steels (above 200,000 psi tensile). Others are being planned.

The seminars were started early in 1952 by Northrop Aircraft. Their sponsorship was taken over by the SAE Southern California Section so that the seminars could reach and serve more engineers in the industry.

YOU'LL . . .

. . . be interested to know that . . .

TWO hundred and thirty applications were received in February making it the best February in SAE history . . . also that a total of 2538 applications was counted for the 12-month period ending February 28. Best previous 12-month figure ended Aug. 31, 1944, with a total of 2508.

AMENDMENTS . . .

. . . to SAE Constitution have been adopted by mail vote of voting members.

AMENDMENTS to the SAE Constitution detailed on pp. 56-58 of the November, 1952 SAE Journal have been adopted by a mail vote of the voting members of the Society. Ballots were counted on March 3, 1953.

SAE Journal in China . . .

SAE Journal is number three on this list of publications available in the library of the Chinese Nationalist airline, C.A.T. The picture appeared in an "Aviation Week" story on the LST (landing ship transport) that the airline has fitted up with maintenance shops. When author George Christian visited the ship some months ago and took the picture, it was tied up at a port on Formosa, ready to move fast if the Chinese Communists attacked.

W. J. KUNZ, JR.

. . . wins Wright Brothers Award for paper on investigation of compressor stall.

W. J. KUNZ, JR. of Bendix Aviation Corp. will receive the Wright Brothers Medal for 1952 at the SAE Aeronautic Meeting dinner on April 23.

The award goes to Kunz for his paper "A New Technique For Investigating Jet Engine Compressor Stall and Other Transient Characteristics,"

which he presented at the SAE Spring Aeronautic Meeting in New York a year ago. In it, he describes an automatic two-pen plotting board device. One pen plots fuel supplied to the engine to maintain a predetermined turbine temperature. The second pen plots the compressor discharge pressure with respect to engine speed. As engine speed is varied, compressor stall shows up as a sharp decrease in compressor discharge pressure. The board enables investigators to determine the boundaries of compressor stall and the corresponding fuel flows.

Kunz and his colleagues at Bendix use the plotting board device in determining design requirements for turbine engine fuel controls.

R. C. Loomis, chairman of the Wright Brothers Board of Award, will make the presentation of the medal to Kunz. Serving with Loomis on the Board were Ray D. Kelly and R. J. Woods.

Peale to Address SAE

MUNDY I. PEALE will be the principal speaker at the dinner Thursday, April 23, climaxing the SAE National Aeronautic Meeting, April 20–24. The dinner, like the technical sessions, will be held in the Hotel Statler in New York.

As president of Republic Aviation Corp., Peale has been an active supporter of SAE aeronautic standardization work. He is currently chairman of the Aircraft Industries Association of America, Inc.

Mundy I. Peale

Admiral DeWitt C. Ramsey, president of AIA, will serve as toastmaster at the dinner.

National Meetings . . .

Meeting	Date	Hotel
	1953	
AERONAUTIC PRODUCTION FORUM	April 20	Hotel McAlpin and Hotel Governor Clinton, New York City
and		
NATIONAL AERONAUTIC MEETING and AIRCRAFT ENGINEERING DISPLAY	April 21-23	Hotel Statler, New York City
SUMMER	June 7-12	The Ambassador and Ritz-Carlton Atlantic City, N. J.
INTERNATIONAL WEST COAST	Aug. 17-19	Georgia Hotel, Vancouver, B. C.
TRACTOR and PRODUCTION FORUM	Sept. 14-17	Hotel Schroeder, Milwaukee
AERONAUTIC MEETING and AIRCRAFT ENGINEERING DISPLAY and AIRCRAFT PRODUCTION FORUM	Sept. 29-Oct. 3	Hotel Statler, Los Angeles
INTERNATIONAL PRODUCTION	Oct. 29-30	Royal York Hotel, Toronto
TRANSPORTATION	Nov. 2-4	Conrad Hilton, Chicago
DIESEL ENGINE	Nov. 3-4	Conrad Hilton, Chicago
FUELS & LUBRICANTS	Nov. 5-6	Conrad Hilton, Chicago
	1954	
ANNUAL and ENGINEERING DISPLAY	Jan. 11-15	The Sheraton-Cadillac and Hotel Statler, Detroit
PASSENGER CAR, BODY, and MATERIALS	March 2-4	Hotel Statler, Detroit

Program for

1953 SAE National Aeronautic Meeting, Aeronautic Production Forum, and Engineering Display

April 20-24

Hotels

McAlpin — Governor Clinton — Statler

Aeronautic Production Forum

"Breaking Through Bottlenecks in Aeronautic Production"

Sponsored by SAE Production Activity

R. T. Hurley, President, Curtiss-Wright Corp.
Sponsor

Dr. Michael Field, Partner, Metcut Research Associates
Chairman

Ten separate informal gatherings to exchange information and experience on vital aeronautic production problems. Each group will have a panel of experts available all day to answer questions.

Monday, April 20

Each panel will be held in the hotel indicated

Time Schedule for All Panels—

10:00 a.m.—12:00 Noon; 2:00 p.m.—4:00 p.m.

Hotel McAlpin

Experimental Manufacturing:

Getting a New Design into Production —Hotel McAlpin

Fundamental responsibility faced by experimental procurement groups is rapid, low cost procurement of experimental components. These components may involve new manufacturing techniques and materials. Underlying the program is development of vendors and processes aimed at ultimate transition to production. Among the factors faced are:

1. Make or buy considerations.
2. Vendor development, both technical and financial.
3. Permanent versus temporary tooling.
4. Relationship between the designer and the experimental manufacturing group, particularly as to productibility evaluation.
5. Special quality control problems.

Panel Leader:
ALLEN CHILTON, Development Director of Experimental Operations, Wright Aeronautical Div., Curtiss-Wright Corp.

Panel Secretary:
G. E. NELSON, President, G. E. Nelson Co.

Panel Members:
J. W. CHALUPA, Assistant Manager of Manufacturing, Aircraft Gas Turbine Div., Westinghouse Electric Corp.
KARL SCHEUCHER, Factory Engineer, Jet Division, Thompson Products, Inc.
JOSEPH BALLARD, Chief of Experimental Operations, Pratt & Whitney Aircraft Div., United Aircraft Corp.
P. W. SCHIPPER, General Manager, Douglas Tool Co.
E. N. LAURANCE, Divisional Superintendent, Glenn L. Martin Co.

Production Procurement:

What It Means to Buyer and Vendor —Hotel McAlpin

Farming out parts and assemblies for manufacture brings problems to prime contractor and subcontractor alike, as well as to the military customer. It involves relationships among these groups as well as operations within their own organizations. Affected are overall costs, controls, and manufacturing schedules. Also involved are:

1. Source development . . . techniques used and results obtained.
2. Policies and relations with subcontractors.
3. Maintenance of engineering change control as related to subcontractors versus mandatory requirements of the end product.
4. Vendor follow-up methods as related to master planning requirements.
5. Internal and external dissemination of information.

Panel Leader:
J. RALPH WALKER, Assistant Procurement Manager, Fairchild Engine Div., Fairchild Engine and Airplane Corp.

Panel Secretary:
D. C. FEHLEISEN, Assistant Production Control Manager, Fairchild Engine Div., Fairchild Engine and Airplane Corp.

Panel Members:
A. C. HARTMAN, Production Manager, Air Associates Inc.
C. E. REID, Procurement Director, Republic Aviation Corp.
J. W. DUNNELL, Purchasing Manager, Pratt & Whitney Aircraft Div., United Aircraft Corp.
E. T. STURGIS, JR., Purchasing Agent, The Glenn L. Martin Co.

Machining:

Finding Feasible Methods for Finicky New Metals —Hotel McAlpin

A host of new challenges faces the aeronautic manufacturing man concerned with metal cutting . . . new high-temperature alloys, thin sections and rings for gas turbines, tapered sections and integrally reinforced sections for airframes. He'll get some of the answers he's looking for by hearing about:

1. New methods of machining high-temperature alloys and stainless steel.
2. New methods for producing tapered sheet and thin sections.
3. Heat-treating materials for improved machinability.
4. What is new in lubricants and lubrication methods for aircraft production.
5. Specialized machine tools for aircraft production.
6. What is new in testing techniques for machinability data.

Panel Leader:
K. W. STALKER, Supervisor Manufacturing Methods, Aircraft Gas Turbine Div., General Electric Co.

Panel Secretary:
E. J. WELLER, Engineer, General Electric Co.

Panel Members:
R. A. WINBLAD, Assistant Manager Engineering Service Dept., Cincinnati Milling Machine Co.
NORMAN ZLATIN, Partner, Metcut Research Associates.
R. C. GIBBONS, Chief Metallurgist, Utica Div., Bendix Aviation Corp.
C. W. SMALL, Chemical Section Supervisor, Thompson Products, Inc.
HENRY ALBERT, Assistant Factory Superintendent, Republic Aviation Corp.
D. C. ALDRICH, Sales Engineer, G. F. Pierce Co.

Machine Tools and Tooling:

What Are Today's Trends? —Hotel McAlpin

10:00 a.m.—12:00 Noon

A decision many plants are making today is whether to use single-purpose machine tools or universal type machine tools with modified tooling. Then, too, what kind of tools is another problem . . . new, rebuilt, or foreign. These considerations will be aired in discussions of:

1. New machine tool development to satisfy requirements for future aircraft and engines.
2. Machine jigs and fixtures for new machine tools being built.
3. Special machine tools available for aircraft engine and airframe manufacturers.
4. Procurement of machine tools, both new and used.

5. Evaluation of the types of imported machine tools available and comparative costs.
6. Maintenance of machine tools covering types of control.

2:00 p.m.—4:00 p.m.

The entire field of aircraft tooling will be discussed from the standpoint of economics. What factors determine basic tooling policies? What means are being employed to keep tooling costs to a minimum? How can we develop realistic tool cost estimates? These are but a few of the questions to be answered by this panel of experts.

1. Tool costs as effected by airframe structural design. (Large one-piece components vs. conventional design).
2. Prototype tooling policy (How to keep costs down on prototype tooling).
3. Tool cost estimates (How developed, degree of accuracy, and use).
4. Optical tooling and masters (When to use, cost comparisons with other methods).
5. Tool research and tooling methods (Objective, what is being done?)
6. Tool type evaluation (Break-even point based on quantity and rate).
7. Measurement of tool shop performance through tool estimates.

Panel Leader:
I. J. KEOUGH, Assistant Factory Manager, Republic Aviation Corp.

Panel Secretary:
ADAM HETZER, Manufacturing Processing Section Head, Republic Aviation Corp.

Panel Members:
J. L. GEIST, Supervisor of Tooling, Westinghouse Electric Corp.
HENRY MAEHL, Manager of Production Engineering, Fairchild Engine Div., Fairchild Engine and Airplane Corp.
J. E. BATEMAN, Manufacturing Engineering, Aircraft Engine Div., Ford Motor Co.
W. M. ENGELBRECHT, General Master Mechanic, Chrysler Jet Engine Plant, Chrysler Corp.
J. J. JAEGER, Assistant Manager, Machine Engineering Dept., Pratt and Whitney Div., Niles-Bement-Pond Co.
A. KASTELOWITZ, Chief Tool Engineer, Republic Aviation Corp.

Titanium:

A Realistic Look at the New Metal
—Hotel McAlpin

There's hardly an aeronautic company that isn't looking into titanium and its possibilities. Much remains to be learned about its properties. Each day the fund of knowledge advances. The panel will discuss the latest information on:

1. Raw Material Processing—quality of the sponge, melting, forging of billets, closed and open die forgings, and rolling bar and sheet.
2. Alloys Available—various type titanium based alloys, their properties at various temperatures, specifications, and new type alloys likely to be produced.
3. Application—uses in aircraft, why titanium is chosen, appraisal of cost and availability picture, and a discussion of welding, brazing, and machining problems.

Panel Leader:
W. L. FINLAY, Research Manager, Rem-Cru Titanium, Inc.

Panel Secretary:
ROBERT JAFFEE, Supervising Metallurgist, Battelle Memorial Institute

Panel Members:
W. S. HAZELTON, Metallurgical Engineer, Aircraft Gas Turbine Div., Westinghouse Electric Corp.
ROBERT STEWART, Associate Director of Research, Allegheny Ludlum Steel Corp.
PAUL MAYNARD, Material and Process Engineer, North American Aviation Corp.
R. J. BULLOCK, Development Engineer, Wyman-Gordon Co.
L. D. JAFFE, Chief Physical Metallurgy Section, Watertown Arsenal Laboratory

Jet Engine Buckets and Blades:

What's the Best Way to Make Them?
—Hotel McAlpin

What's the best and most economical way of producing compressor buckets and turbine blades in the quantities desired? The basic information for making such an evaluation is still being evolved. Discussion, covering the relative merits of each technique and when to use it, will encompass:

1. Forgings—rough or precision.
2. Castings—sand or precision investment.
3. Special fabricating techniques, such as rolling, coining, stamping, and pressing.
4. Surface finishing, including abrasive, chemical, electrolytic, and shot peening.
5. Inspection methods covering mechanical, optical electrical, and pneumatic devices.

Panel Leader:
W. M. WILLIAMS, Factory Manager, Jet Engine Div., Thompson Products, Inc.

Panel Secretary:
C. C. CLARK, Assistant Factory Manager, Metallurgical Products Div., Thompson Products, Inc.

Panel Members:
C. P. BROOKS, Factory Manager, Microcast Div., Austenal Laboratories, Inc.
L. M. RARING, Chief Metallurgist, Utica Drop Forge and Tool Corp.
J. V. RICKARD, Manufacturing Engineering Manager, Metals Processing Div., Curtiss-Wright Corp.
E. H. JONES, Executive Engineer, Ex-Cell-O Corp.
R. L. GRUNEWALD, Manager of Components Manufacturing Section, Evendale Engine Operation, General Electric Co.
P. C. AMBROSE, Group Leader of Blades and Buckets, Pratt and Whitney Aircraft Div., United Aircraft Corp.

Manufacturing Management:

Controlling Men, Machines, Materials, and Money —Hotel McAlpin

Getting the most out of a manufacturing enterprise compels management to use tools to control, coordinate, and integrate the various segments of its organizations. These tools must be put to work in:

1. Organization to envelop the full scope of production responsibility, which covers production control, inventory control, purchasing relations, staff functioning, and personnel development.
2. Scheduling and shop loading, using unit and direct labor systems and long and short range forecasting.
3. Production control systems to tie in with mechanics, dispatching, expediting and changes, as well as integration with wage payment and manufacturing plans.
4. Inventory control covering facets such as turnover budgets, economical ordering, stock records, stockkeeping, manufacturing cycle control, physical inventory, and the selling of inventory control.
5. Management controls and their evaluation . . . promises kept, expense budgets and ratios, inventory turnover, output billing, manufacturing losses, and actual direct labor versus planned.

Panel Leader:
H. FORD DICKIE, Manager, Aeronautics and Ordnance Manufacturing, General Electric Co.

Panel Secretary:
D. F. TIMBERLAKE, Advanced Manufacturing Training Program, General Electric Co.

Panel Members:
P. F. WEBER, Factory Manager, Kollsman Instrument Co.
R. T. NALLE, JR., Manager of Production, Aviation Gas Turbine Div., Westinghouse Electric Corp.
F. PENN HOLTER, Assistant General Manager, Wright Aeronautical Div., Curtiss-Wright Corp.
HARRY LAMPE, Time Study Supervisor, Republic Aviation Corp.
C. L. FARRAND, President, Farrand Optical Co.

Hotel Governor Clinton

Inspection and Quality Control:

Who Controls It, with What, and How
—Hotel Governor Clinton

Controlling quality in aeronautic production has its controversial aspects. There are differences of opinion and more than one answer to questions such as:

- To what extent are quality and production responsible for the overall quality of the end product?
- How far should statistical control be used as a unit of measure to determine quality controls on materials in process?
- Who should check critical lots 100% after statistical control rejection?

In discussing these points, the following also will be covered:

1. Tool and gage control.
2. Corrective action taken for recurring discrepancies.
3. Latest inspection methods and devices.
4. Inspection techniques in airframe manufacture.
5. Inspection techniques in aircraft engine manufacture.
6. Military quality specifications.
7. Quality control for subcontractors.

Panel Leader:
E. S. MARKS, Quality Manager, Pratt and Whitney Aircraft Div., United Aircraft Corp.

Panel Secretary:
D. E. TAYLOR, Supervisor, Manufacturing Quality Control, Pratt and Whitney Aircraft Div., United Aircraft Corp.

Panel Members:
C. W. KENNEDY, Quality Control Engineer, Federal Products Corp.
E. D. BRYANT, Director of Quality, Fairchild Engine Div., Fairchild Engine and Airplane Corp.
E. J. ZALANKA, Chief, USAF Quality Control Branch, Republic Aviation Corp.
FRANK SHAW, President, Shaw Metal Products Corp.
F. W. ROHDE, Manager, Quality Control, Aviation Gas Turbine Div., Westinghouse Electric Corp.

Large Forgings and Castings:

Why Is It Tough to Produce Them?
—Hotel Governor Clinton

Demand for production economy in materials, strategic alloys, and manpower has accentuated a current manufacturing must: Fabricating methods that permit reduction of machining stock and simplification of component design. Modern forging, casting, and extrusion techniques should point the way to economy-producing developments. Among the more promising of these developments are:

1. Large press forgings for airframe components.
2. Extrusion of large shapes and billets.
3. Steel and nodular iron castings.
4. Centrifugal castings.
5. Light alloy castings.

Panel Leader:
G. W. MOTHERWELL, Vice president, Charge of Manufacturing, Worcester Div., Wyman-Gordon Co.

Panel Secretary:
J. R. DOUSLIN, Superintendent, Grafton Plant, Wyman-Gordon Co.

Panel Members:
ALEXANDER ZEITLIN, Vice President, Loewy Construction Co., Inc
W. C. SCHULTE, Chief Metallurgist, Curtiss Propeller Division, Curtiss-Wright Corp.
FRANK HERLIHY, Assistant Chief Metallurgist, American Brake Shoe Co.
W. A. DEAN, Chief Metallurgist, Cleveland Works, Aluminum Co. of America
G. D. WELTY, Product Manager, Forging Div., Aluminum Co. of America
GERHARD ANSEL, Technical Director, Madison Div., Dow Chemical Co.
PAUL P. ZEIGLER, Director of Metallurgical Research Div., Kaiser Aluminum & Chemical Corp.

Precision Forming and Joining:

Sheet Metal Goes to Work in Engines:
—Hotel Governor Clinton

Forming and joining techniques have taken on added importance since the advent of turbojet and turboprop engines. That's because sheet metal fabrication—once the province of the airframe producer—now is also a major concern of the engine builder. He has to cope with new as well as old ways of handling heat-resistant alloys. His problems include:

1. Sheet metal design and fabrication.
2. Forming methods, both experimental and production.
3. Resistance and fusion welding methods.
4. Brazing.
5. Riveting.
6. Coin dimpling.

Panel Leader:
MICHAEL WATTER, Director of Research, The Budd Co.

Panel Secretary:
M. H. JOYCE, JR., Research Engineer, The Budd Co.

Panel Members:
J. S. SOHN, Section Head, Process Research & Development, Wright Aeronautical Div., Curtiss-Wright Corp.
W. H. D'ARDENNE, Chief Engineer, Research, Heintz Manufacturing Co.
H. M. WEBBER, Application Engineer, General Electric Co.
F. J. GARDINER, Chief Engineer Special Products Div., ITE Circuit Breaker Co.

Technical Sessions

Hotel Statler

Tuesday, April 21

Full Day of Aeronautic Confidential Sessions

Attendance will be restricted to those who have previously been cleared for these sessions by the U. S. Air Force.

9:30 a.m. **Penntop South**

WELCOME—**R. F. Gagg,** General Chairman of Meeting

Confidential Session

Chairman—**A. T. Colwell,** Thompson Products, Inc.

SYMPOSIUM—Service Experience with Turbojet Engines

The Navy's Experience with Turbojet Engines
J. D. Clark, Bureau of Aeronautics, Navy Department

Turbojet Engines—Workhorses of Today's Air Force
R. W. Kinney, Power Plant Laboratory, Wright Air Development Center

(Sponsored by Aircraft Powerplant Activity)

2:00 p.m. **Penntop South**

Confidential Session

Chairman—**C. C. Furnas,** Director, Cornell Aeronautical Laboratories

Progress and Current Problems in Guided Missile Development

The Nike Guided Missile System
J. M. West, Bell Telephone Laboratories

Development and Testing of the Regulus Missile
R. C. Blaylock, Chance Vought Aircraft Division, United Aircraft Corp.

Development of Falcon Missile
Allen Puckett, Hughes Aircraft Co.

(Sponsored by Aircraft Activity)

8:00 p.m. **Penntop South**

Confidential Session

Chairman—**A. R. Parilla,** M. W. Kellogg Co.

SYMPOSIUM—Flight Experience with Rocket Powerplants

Development and Testing of a Liquid-Assist Take-Off Rocket for the F-84 Airplane
C. C. Ross and **J. J. Peterson,** Aerojet Engineering Corp.

Flight Experience with the Rocket Powerplant of the Viking Missile
J. H. Wyld, Reaction Motors, Inc.
Illustrated by motion picture of Viking Rocket Tests at White Sands.

Soviet Rocket Powerplant Development
Alfred Veedisch, Jr., Air Technical Intelligence Center, Wright-Patterson Air Force Base

(Sponsored by Aircraft Powerplant Activity)

Wednesday, April 22

9:30 a.m. **Penntop South**

Chairman—**F. O. Hosterman,** Weston Hydraulics, Ltd.
Secretary—**F. H. Pollard,** Republic Aviation Corp.

SYMPOSIUM—High-Temperature Hydraulic Systems

High-Temperature Problems Associated with Aircraft Hydraulic Systems
F. C. Mitteli, North American Aviation, Inc.

Adventures in Extreme Temperature Hydraulics
George Keller, Downey Division, North American Aviation, Inc.

Limitations of Synthetic Rubber Packings for High-Temperature Applications
E. L. Carlotta and **E. Hobein,** Parker Appliance Co.

The Development of High-Temperature Hydraulic Fluid
Lieut. J. A. King and **J. C. Mosteller,** Materials Laboratory, Wright Air Development Center

Supersonic flight poses new aircraft design problems related to elevated temperatures. Since heat now is the major headache of hydraulics engineers, need is indicated for reviewing problems and surveying solutions.
(Sponsored by Aircraft and Air Transport Activities with the cooperation of SAE Committee A-6)

2:00 p.m. **Penntop South**

Chairman—**Capt. W. T. Hines,** U. S. Naval Air Turbine Test Station
Secretary—**E. G. Whitney,** Fairchild Engine and Airplane Corp.

Simulated Flight for Engines at AEDC
G. W. Newton, Aro, Inc.

Engineers have, in effect, put wings on engine test stands at a new testing plant in Tennessee. Jets are operated on the ground under atmospheric temperature ranges and at altitudes encountered in flight.

Turbojet Research Techniques Utilized in Altitude Facilities
W. A. Fleming and **H. D. Wilsted,** Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics

Laboratory research is developing specialized techniques and instrumentation methods which accurately preview engine performance. Effective are new ways for extending maximum altitudes and for minimizing essential powerplant performance data.

(Sponsored by Aircraft Powerplant Activity)

2:00 p.m. **Skytop**

Chairman—**Harry Cornish** Douglas Aircraft Co., Inc.
Secretary—**R. E. Middleton,** Lockheed Aircraft Corp.

Design for Increased Reliability of Aircraft Hydraulic Systems
L. M. Chattler, Bureau of Aeronautics, Navy Department

Designing Hydraulic Systems to Increase Dependability of Tomorrow's Airplanes
Howard Field, Jr., Consolidated Vultee Aircraft Corp.

Design and Development of Aircraft Hydraulic Components for Increased Reliability
J. W. Kelly, Adel Division, General Metals Corp.

Dependability and speed, desiderata of future planes, are related problems, their solution affecting performance. Check-off of ten pertinent factors gives realism to design thinking about hydraulic systems.

(Sponsored by Aircraft and Air Transport Activities with the cooperation of SAE Committee A-6)

8:00 p.m. **Penntop South**

Chairman—**O. E. Kirchner,** American Airlines, Inc.
Secretary—**G. W. Gilmer,** Arabian American Oil Co.

A Review of Comet Experience
C. H. Jackson, British Overseas Airways Corp.
Comet fulfillment of commercial and operational expectations establishes high cruising speeds as mandatory. Study of engineering and operational experience is essential to greater efficiencies and economies.

Factors Influencing Airplane Costs
J. W. Barton, Boeing Airplane Co.
The sound barrier is passed, but the cost barrier remains inexorably forbidding and hazardous as technological advances spiral expenses. Cost factors must be identified and rationalized before jet transports become financially acceptable.
(Sponsored by Air Transport Activity)

8:00 p.m. **Skytop**

Chairman—**A. H. Hobelmann,** Walter Kidde and Co., Inc.
Secretary—**H. F. Peppel,** Walter Kidde and Co., Inc.

A Method for Predicting Pressure Drops in Pneumatic Components and Systems
M. M. Slawsky and **Morton Lutzky,** National Bureau of Standards, and **A. E. Schmidlin,** Walter Kidde and Co., Inc.

Production and Maintenance Experience with High-Pressure Pneumatics in Fighter Aircraft
W. D. Clark, Republic Aviation Corp.

Pneumatic Actuating Systems in the United States Air Force
R. R. Bayuk, Wright Air Development Center

Combining pneumatic and hydraulic systems for aircraft control affords specific advantages. Research, testing, and evaluation presage extended future use, but only after bug-eradication.
(Sponsored by Aircraft and Air Transport Activities with the cooperation of SAE Committee A-6)

Be sure to visit the

Aircraft Engineering Display

April 21-23—Penntop North

Hours: 9:30 a.m.—10:00 p.m.,

Tuesday and Wednesday, April 21 and 22.

9:30 a.m.—5:00 p.m., Thursday, April 23.

Twenty-six outstanding exhibits featuring up-to-the-minute aeronautical developments.

Thursday, April 23

9:30 a.m. **Penntop South**

Chairman—**William Littlewood,** American Airlines, Inc.
Secretary—**O. E. Kirchner,** American Airlines, Inc.

Optimum Location of Engines on Jet Transports
Why Pod-Mounted Engines Make Sense
G. S. Schairer, Boeing Airplane Co.
Rivaling in difficulty the decision as to what engine to use is the question where to mount it. Practical considerations, including overall performance, may shift the trend to pod-mounting.

High Speed Transport Turbojet Installation Considerations
B. T. Salmon, Consolidated Vultee Aircraft Corp.
Words and pictures answer pertinent questions relating to drag, weight, fuel economy, and serviceability raised when jet engines are installed in transport aircraft—whether in wings or in nacelles.

Jet Engines from the Operator's Viewpoint
H. N. Taylor and **W. W. Davies,** United Air Lines, Inc.
High initial and amortization costs of jet transports demand planes airworthy, usable, and operating a majority of the time. Powerplants and accessories must be packaged for expeditious servicing, removal, and replacement.
(Sponsored by Aircraft Activity)

2:00 p.m. **Penntop South**

Chairman—**H. E. Gray,** Pan American World Airways, Inc.
Secretary—**R. D. Speas,** Aviation Consultant

Cockpit Standardization—How Far Now and in Future?
M. G. Beard, American Airlines, Inc.
Progress in cockpit standardization is governed by present and prospective desirabilities, scopes, and aspects—all outlined in this informative report of SAE Committee S-7.

Aircraft Instrument Integral Lighting
J. H. Achilich, Special Devices Center, Office of Naval Research
Light and instruments are unitized by centering the light in the window and using a dial of translucent plastic. Data appear matte white in diffuse reflected light, meeting all operating requirements.

Aviation Fuel Economy and Quality—Brothers Under the Aircraft Skin
H. E. Alquist, Phillips Petroleum Co., **E. A. Droegemueller,** Pratt and Whitney Aircraft Division, United Aircraft Corp., and **H. N. Taylor,** United Air Lines, Inc.
Use of large piston-powered transports necessitates study of engine-operating procedures for maximum economy. Fuller utilization of fuel potentials produces economies under known conditions of air-fuel ratios, spark advance, and engine cooling drag.
(Sponsored by Air Transport Activity)

Dinner

7:00 p.m. **Grand Ballroom**

Leslie Peat, Chairman,
SAE Metropolitan Section

Toastmaster
Adm. DeWitt C. Ramsey,
President, Aircraft Industries Association of America, Inc.

Presentation of
Wright Brothers Award
to W. J. KUNZ, JR.
by R. C. LOOMIS,
Chairman, Wright Brothers Board of Award

Robert Cass,
SAE President

U.S. Air Power Today and Tomorrow
An Appraisal of the Build-up

Mundy I. Peale,
President, Republic Aviation Corp.

Friday, April 24

Inspection Trip

Arnold Engineering Development Center
Tullahoma, Tennessee

The U. S. Air Force has invited SAE members and guests to visit the Arnold Engineering Development Center at Tullahoma, Tennessee, on Friday, April 24, 1953.

SAE admission tickets are required for admission to the Center. Tickets may be obtained by applying to SAE Headquarters, 29 West 39 St., New York 18, N. Y.

SAE Section Meetings

April

British Columbia—April 13 and 27

April 13—Dinner 6:30 p.m., meeting 8:00 p.m. Piston Ring Developments—A. J. Wiegand, chief engineer, Perfect Circle Corp.

April 27—Dinner 6:30 p.m., meeting 8:00 p.m. Exhaust Turbo-Charging of Diesel Engines—L. L. Bower, chief engineer, Waukesha Motor Co.

Buffalo—April 21

Rochester, N. Y. Dinner 6:30 p.m., meeting 8:00 p.m. Frigidaire Automobile Air Conditioning — Daniel McCoy, Frigidaire Division, GMC. This is a combined meeting of SAE Buffalo Section with the Rochester Sub-Section.

Canadian—April 17

Prince Edward Hotel, Windsor, Ont. Dinner 6:30 p.m., meeting 8:00 p.m. Fathoming the Fifties — Kenneth McFarland, General Motors Corp.

Cincinnati—April 27

Plant tour of the Cincinnati Milling Machine Co.

Cleveland—April 20

Tomlinson Hall. Student meeting. Speaker—Robert Jackson.

Colorado—April 24

Park Hill Country Club. Meeting 8:00 p.m. Ladies Night.

Detroit—April 13 and 28

April 13—Commodore Perry Hotel, Toledo. Dinner 6:45 p.m. Future Automotive Powerplants—V. G. Raviolo, executive engineer, Ford Motor Co. Toastmaster—H. B. Speyer, vice-president, Champion Spark Plug Co. Tour of Champion Spark Plug Plant, Toledo—4:00 p.m.

April 28—Junior Group, SAE Detroit Section—Tour of Cadillac Motor Car Division production facilities at 2:00 p.m.

Indiana—April 16

Purdue Memorial Union Bldg., Lafayette, Ind. Dinner 6:30 p.m., meeting 7:30 p.m. The New Buick V-8 Engine—V. P. Mathews, vice-president and chief engineer, Buick Motor Division, GMC. Presentation of awards to winners in a student contest sponsored by the Indiana Section.

Metropolitan—April 8 and May 7

April 8 — Engineering Societies Building, 29 W. 39th St., N. Y. C. Meeting 7:45 p.m. Preignition—Fred Bowditch, Research Division, GMC.

May 7—The Brass Rail Restaurant, 43rd and Fifth Ave., N. Y. C. Dinner 6:30 p.m., meeting 7:45 p.m. Your Car Can Beat the Heat—D. C. McCoy, Frigidaire Division, GMC, also M. W. Baker of GMC.

Milwaukee—May 1

Two-Cycle Outboard Engines—W. Clay Conover, chief engineer, Outboard Marine Mfg. Co. Plant trip 1:30 p.m. Harley-Davidson Motor Co.

Mohawk-Hudson—May 8

Locomotive Club, Schenectady. Ladies Night. G. E.'s House of Magic. Buffet Supper, dancing.

New England—May 5

M.I.T., Cambridge. Dinner 7:00 p.m., meeting 8:00 p.m. Transportation and Maintenance—Emil P. Gohn, automotive engineer, Atlantic Refining Co. Highway transportation and commercial vehicles.

Philadelphia—April 8

Engineers Club, 1317 Spruce St., Phila. Dinner 6:30 p.m., meeting 7:45 p.m. Recent Developments in Brakes—Francis J. Markey, products engineer, Moraine Products Division, GMC.

St. Louis—April 14

Gatesworth Hotel, 245 Union. Dinner 7:00 p.m., meeting 8:00 p.m. A New World in Automotive Engineering—Arthur L. Lowell, chief of missile developments, McDonnell Aircraft Co.

Salt Lake City—May 4

Performance Characteristics of Spark Ignition Engines—Carl Ryan, manager, West Coast Automotive Testing Laboratory, E. I. du Pont de Nemours & Co., Inc.

Southern California—April 16

Rodger Young Auditorium, 936 W. Washington Bldg., Los Angeles, Calif. Dinner 6:30 p.m., meeting 8:00 p.m. Exhaust Turbo-Charging of Diesel Engines—L. L. Bower, chief engineer, Waukesha Motor Co.

Texas—April 16

Social Hour 6:30 p.m. Italian Village Restaurant, Dallas. Dinner 7:30 p.m., meeting 8:30 p.m. Railroad Diesels—William F. Kascal, mechanical superintendent, Texas & Pacific Railroad. 1953 SAE President Robert Cass.

Twin-City—April 8

Curtis Hotel. Dinner 6:30 p.m., meeting 8:00 p.m. Modern Gas Turbines — Reeves Morrison, Pratt & Whitney Aircraft, Division of United Aircraft Corp. Joint meeting of local section of Institute of Aeronautical Sciences.

Washington—April 21

Burlington Hotel. Dinner 6:15 p.m., meeting 8:15 p.m. Tires and Tubes for Your Truck—A. W. Bull, director of development, U. S. Rubber Co.

Williamsport—May 4

Antlers Country Club. Dinner 6:45 p.m., meeting 8:00 p.m. Winterization of Automotive Vehicles—Marc Resek, director of engineering, Perfection Stove Co.

Western Michigan—April 21

Grand Rapids, Michigan. Dinner 6:30 p.m., meeting 8:00 p.m. Twelve-Volt Ignition System—H. L. Hartzell, Delco-Remy Division, GMC.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

SAE Section Meetings

Gives History Of Material Handling

• Salt Lake Group

J. P. Bywater, Field Editor

Feb. 5—Since its beginnings during the first World War, the modern mechanical material handling truck has come to play an increasingly important role in industry, **H. R. Peck** told members and guests of Salt Lake Group. The modern truck goes a long way towards solving the problem of material handling costs that cannot be passed on to the consumer.

During World War I, simple platform trucks evolved into the elevating platform type with skids, and later into the high lift platform truck, explained Peck, who is field engineer for the Baker-Raulang Co.

Later, the steel industry's need for a machine to lift heavy rolls of steel caused engineers to develop a hydraulically-operated vertical mast for the front of the truck, which raised and lowered a ram on the front of the mast. Then two forks replaced the ram, so that bundles of steel could be moved without tying up overhead cranes. Fork-lift trucks came into their own during World War II, when the Navy made a study of material handling and specified in its contracts that supplies be shipped in standard pallet load groups, to minimize cost and time of handling.

Since the war, efficiency has been greatly increased by the development of new attachments, such as cranes, booms, rams, clamps, scoops, revolving heads, side-shifters, up-enders, and pushers, which can be quickly changed for the standard forks to meet almost any special material handling situation. Peck emphasized the importance of having the right equipment for the job.

Discussion indicated that the fewer moving parts of the electric material handling truck gives it a maintenance advantage over combustion engine machines, while the short wheel base and low weight of the electric machine make for greater maneuverability.

Chairman Dean Despain examines slides shown by H. R. Peck (left) of the Baker-Raulang Co. in his talk on the development of material handling trucks. At right is H. W. Howells of Riter Engineering Co.

Ordnance Aims At Standardized Vehicles

• Southern New England Section

A. D. Nichols, Field Editor

March 4—Interchangeability and standardization of parts has been one of the many objectives in the design of modern ordnance vehicles, said **Maj. W. O. Miller**, project engineer on combat vehicles at Aberdeen Proving Ground.

Since 1947 an entirely new series of vehicles has been produced and thoroughly tested at Aberdeen Proving Ground and at the high ambient and desert testing station at Yuma, Ariz., and the low temperature test installation at Devil's Lake, N. D., and also at Fort Churchill, Canada in very low temperatures. These vehicles have been tested in all types of terrain and some have also been combat tested.

Since World War II, most of the track laying vehicles utilize only two basic automatic torque converter type transmissions. During this time Army Ordnance has been working on a program to accomplish three broad major objectives: (a), to provide as far as possible a basic transmission for both wheeled and track laying vehicles; (b), to obtain better fuel economy and performance; and (c), to simplify both from operation and maintenance points of view and to reduce costs. The above objectives have been realized in many respects and at the same time dependance on the driver and driver fatigue has been reduced.

Two Engines Replace Six

The progress made in tank engines since World War II has also been remarkable. Today, only two aircooled tank engines with numerous standardized and interchangeable parts, replace the six improvised engines of World War II.

For example, Miller listed some of the improvements made in the 90 mm gun tank power package: Removal time has been reduced from 18 man hours to 4; gross horsepower for cooling reduced from 17% to 13.6; power package weight increased from 6949 to 7013 lb; horsepower increased from 500 to 810; horsepower per lb of engine weight increased from 0.15 to 0.24. Economy has not been sacrificed for these improvements. The fuel consumption in ton-miles per gallon is very little different from the World War II tank.

According to Major Miller, these engines represent the last of the conventional gasoline engines as known today for tank use. Tests are being conducted on fuel injection systems which have many advantages over the present system of fuel induction. Multi-fuel and gas turbine engines are also under development.

SAE Student News

University of British Columbia

The U.B.C. Student Branch played host to members of British Columbia Section at the Feb. 16 meeting, which featured a talk on "The Problem of Escape from the Earth" by **Dr. G. V. Parkinson**, a talk by U.B.C. student **Jim Strain**, and a tour of some of the University's laboratories. Student Branch Chairman Graham Bell presided.

Dr. Parkinson, assistant professor of mechanical engineering at U.B.C., said that before any space travelling could be done we must first get out of the earth's gravitational field. Rockets will probably be used for this, since they carry their own fuel and oxidizing agent and can therefore develop thrust which is independent of the medium through which they travel.

He described the general features of a single-stage rocket propelled by liquid fuel, explaining that the liquid fuels were used instead of solid fuels because they are more easily handled. The well known V-2 rockets of World War II were of this type. He said that a rocket of this type cannot be made to escape the earth's gravitational field because even with the best chemical fuels known 96% of the total weight of the rocket would have to be fuel in order for the rocket to escape. The remaining 4% for structure and payload would present an impossible engineering problem. However, the problem of escape is not impossible with present engineering knowledge. Two possible solutions given were the use of multistage rockets and the use of nuclear power.

Dr. Parkinson ended his talk with a film showing the assembly and launching of the V-2 rockets by the Germans.

Jim Strain, 4th year mechanical engineering student, spoke on "Turbine-Powered Road Vehicles."

Members and guests were taken on a conducted tour of the Mechanical and Metallurgical laboratories at U.B.C.

E. Edvard Anderson

Rensselaer Polytechnic Institute

General Motors Vice-President **Charles A. Chayne** was speaker at the Feb. 4 meeting of the SAE Student Branch at R.P.I. Chairman Fil Fina introduced Chayne and presided over the meeting.

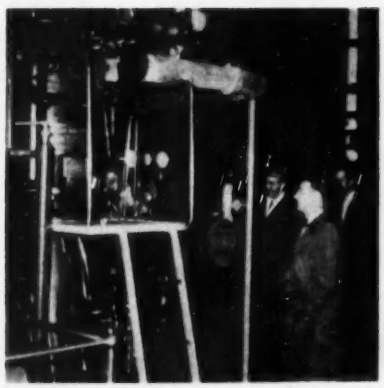
Chayne's talk was concerned with the design of the XP-300, Buick's experimental automobile. He told the background of the "laboratory on wheels" and its counterpart, Le Sabre, which was developed by the General Motors Styling Department at the same time that Buick was building the XP-300.

The car is powered by a 90 deg V-8 engine equipped with overhead valves. The engine has a 335 hp rating at 5500 rpm. It is supercharged and a dual carburetor system is employed, one carburetor for premium gasoline and the other for methanol. The methanol carburetor is not involved in feeding fuel until the gasoline throttle is opened 40%. Then the methanol begins to flow to the cylinders until at full throttle the fuel mixture is 40% gasoline and 60% methanol. A 10 to 1 compression ratio is used in conjunction with a 12-v electrical system utilizing platinum-pointer spark plugs.

The transmission, a Dynaflow torque converter of the same construction as that used in the 1950 Buicks, is placed just behind the passenger compartment. The rear end is a De Dion suspension with coil springs. A German ZF type differential is used in order to transmit some driving force to the wheel which is on solid ground if the other one is slipping.

The front wheels are independently suspended, using torsion springs. All four wheels are equipped with two sets

Students Entertain British Columbia Section Members



Dr. G. V. Parkinson (left) explains the principles of a single-stage rocket in his talk on space travel at the Feb. 16 meeting of the Student Branch at the University of British Columbia. Students played host to members of British Columbia Section, and after the talk took them on a tour of U.B.C.'s mechanical and metallurgical laboratories (center). Snapped during the tour (right) were student Jim Strain, who spoke on turbine-powered road vehicles at the meeting; Student Branch Chairman Graham Bell; Dr. Parkinson; and Section Chairman E. C. Howell

of brake shoes and hydraulic cylinders set side by side. This arrangement was found to be more satisfactory than one extra wide set of brake shoes.

Chayne used slides to illustrate many points of the construction of the engine and chassis. The slides were also used during a question and answer discussion period which followed the regular meeting. Many points pertaining to automobiles in general were brought up, such as disc brakes, fiberglas bodies, rear engines, brake cooling, and so forth.

James Lafferty, Secretary

Pennsylvania State College

On Feb. 17, **J. E. Barfoot** of the Boeing Airplane Co. spoke on "Modern Air Transport."

Slides of graphs and charts were used to show the relative merits of propeller, turboprop, and turbojet engine planes and how they have changed in recent years. Other slides showed early designs of planes now in production and present postulated designs for the planes to be manufactured about ten years in the future.

Joseph K. Thornton, Field Editor

University of Detroit

"Coordination of Engine and Transmissions" was the topic of a talk by **Earl R. Pierce** of General Motors Technical Center on Dec. 10.

Pierce spoke on the various factors which must be considered in the design of an automatic transmission, accompanying his talk with slides.

Donald Duclos, Secretary

Oregon State College

On Feb. 11, the SAE Student Branch at Oregon held its annual social evening.

The function was a pot-luck dinner. Married members and their wives supplied the hot dishes and salads, while the single men were entrusted with the coffee and desserts. The evening ended with the showing of a movie of the Indianapolis 500 mile race.

Next year, the group plans to repeat the successful "get acquainted" meeting in the fall.

Ralph De Palma (left) talks over old times with Cal Poly aircraft engine instructor Roy Metz (right), who at one time was a speedway mechanic, at the Jan. 21 meeting. Looking on are Eric Rosenaugh (far left), ME club secretary, and Bob Aronstein (center), Cal Poly SAE treasurer

University of Washington

At the first meeting of the new quarter, **Mel Orme** of Perfect Circle Corp. explained the correct method of installing piston rings, using a movie to emphasize his points. He discussed the advantages of the top chrome ring, and compared it to other types. The movie stressed the importance of absolute cleanliness in ring installation.

A movie of the Indianapolis 500 mile race of 1952 completed the program.

Richard I. Smith, Secretary

Student Chairman Visits Branches

Ray Faller, chairman of SAE's Student Committee, recently made a transcontinental trip which included visits to a number of SAE Student Branches. He made stops at California Institute of Technology, University of Washington, Cornell, and the University of Michigan.

Faller conferred with Student Branch officers and faculty advisers at these schools and attended meetings whenever possible.

California State Polytechnic College

Ralph De Palma, veteran race car driver and winner of more races than any other man in history, was guest speaker at the annual Cal Poly joint SAE-ME clubs banquet held on Jan. 21 at the San Luis Obispo Veterans Memorial Hall.

Now a member of General Petroleum Corp.'s public relations department, De Palma has addressed thousands of high school youngsters in recent months on behalf of traffic safety. In the 40 years of the Indianapolis race, De Palma has either competed in or viewed all but three such events, and, although he hasn't competed since 1927, he still holds the record for number of laps in the lead (613) of the Memorial Day classic.

Among De Palma's topics of discussion was a comparison of Bill Vukovich's bad luck at Indianapolis Speedway in 1952 to his own bad luck at the same speedway 1912 when De Palma and his mechanic were involved in the famous "pushmobile" incident. De Palma claims that he did not receive a cent in prize money, although he had led the race until his Mercedes race car broke a connecting rod with only two laps to go. But he made up for his bad luck by winning the 1915 Memorial Day classic.

De Palma concluded his talk with the showing of two interesting films, the first on the 1952 Economy Run, and the second on the 1952 500-mile classic.

Oron Palmer, Field Editor

Met Section tours Fisher Body and Chevrolet Plants

Above, left: A group of the 100-odd SAE members, students, servicemen and guests who took the Fisher-Body-Chevrolet tour on Feb. 11 at Tarrytown, N. Y., registering as they entered the Chevrolet assembly plant which turns out 75 completed passenger cars and trucks an hour. The General Motors Divisions provided buses from and to New York and luncheon for the group.

Above, right: One of the small groups being conducted by a plant engineer, left, through the Tarrytown plants. He is flanked by Richard S. Woodbury (right), Section Treasurer, and Fred Smith (left), SAE Headquarters staff.

Left: Nerve center of the Chevrolet assembly plant at Tarrytown is this Telautograph which conveys instructions written by operator, right, to critical points throughout the assembly operations. Instructions from this machine order the correct wheels, fittings and optional equipment for each car as bodies pass the operator from the adjoining Fisher plant.

Fisher Body and Chevrolet plant officials who served as an "ask-me-another" panel following the tour of the Tarrytown assembly lines. Left to right are **W. B. Brownlie**, manager, and **J. Bruce**, superintendent of inspectors of the Chevrolet plant; **E. E. Hintz**, manager, and **A. W. Mason**, chief inspector of the Fisher Body plant; **E. P. Feely**, Chevrolet fleet sales manager from Detroit, and **Charles E. Chambliss, Jr.**, vice-chairman for Passenger Car and Body Activity, Metropolitan Section, who made the arrangements for the all-day tour on Feb. 11.

Cass Outlines Engineering Aims

• Western Michigan Section
A. L. Maring, Field Editor

Feb. 17—The annual President's Dinner of Western Michigan Section, held at Bill Stern's Steak House in Muskegon, honored **Robert Cass**, National President of SAE. The dinner was preceded by a cocktail hour sponsored by Continental Motors Corp.

During the dinner, the honored guests were introduced to the Section. Guests included many leaders of Muskegon industries, Hollister Moore of the SAE staff in New York, and Dick Valuck, winner of the Student Activities award. Maurice W. Bolster was presented with the Past Chairman's certificate.

George Dake, Section chairman, introduced **G. Waine Thomas**, chief engineer of the Automotive Division of Continental Motors Corporation, who served as toastmaster.

President Cass' talk outlined the changes which shortage of certain metals and economic pressures will bring about in car designs of the future.

Copper is a very scarce material at this time, and already half of the copper used in this country comes from abroad. All auto manufacturers are searching for a suitable substitute material for use in the cooling and electrical systems of cars.

Nickel is another material that is rapidly disappearing, Cass declared. At present only one pound of nickel per car is allowed. It may be used in thermostats, some in valves, and a very little under the chrome on the bumpers. The U. S. has only 10 to 15% of the available supply of nickel and a substitute is badly needed.

Cass stated that economic pressure on certain income groups, together with the mounting traffic congestion, particularly in large cities, is steadily making the small car more attractive. He told of recent tests conducted in Cleveland with a fleet of popular, medium-priced cars which showed an average of only seven horsepower used in city driving.

To make their technical knowledge count, engineers must face up to their responsibilities and learn how to handle money and executive positions, Cass declared. An engineer must be able to present problems clearly and get his fair share of the budget.

In closing, Cass mentioned a number of engineering goals for the future. Lighter weight engines, more horsepower, better fuel, better engines to digest fuel additives, improved air and oil cleaners, better diesel engines, gas turbines, and a good small car headed the list.

A small, light car for American motorists was among the engineering goals named by SAE President Robert Cass at Western Michigan Section on Feb. 17. Seated at the head table were, left to right: Dick Valuck, Muskegon Community College student; P. S. Webster of Continental Motors; Hollister Moore of the SAE staff; G. Waine Thomas of Continental; Section Chairman George E. Dake, Jr.; President Cass; William C. Kratz of Anaconda Wire and Cable Co.; Carl E. Allen, president of Campbell, Wyant and Cannon Foundry Co.; Paul C. Johnson, Sealed Power Corp. president; and C. J. Reese, president of Continental Motors

Says Turnpike Best For Highway Transport

• Philadelphia Section
J. A. Daley, Field Editor

Feb. 11—Some facts on our national highway transportation system that were unfamiliar even to most engineers were brought out by **B. B. Bachman**, vice-president in charge of engineering of the Autocar Co., at a meeting chaired by F. W. Kateley, vice-president of engineering for ACF-Brill Motors.

In the early days of this nation, Bachman pointed out, areas located more than a few miles from a seaport, navigable stream or railroad were isolated and almost wholly dependent on local resources. Today, the highway and the truck have made these geographical limitations negligible. In 1949, 75% of the freight hauled in this country was carried by trucks, emphasizing the vital role of the truck in our national growth.

Bachman traced the significant improvements in the major components of the motor truck and its accessories. Developments in tires, engines, transmissions, controls and so forth have not only improved the truck from the standpoint of technical efficiency, but have made it a commercially profitable means of transportation, Bachman emphasized.

Comparative tests conducted on a closed circuit course on the Pennsylvania Turnpike and routes U.S. 30 and 11 cited by Bachman showed a considerable advantage in operation on a modern turnpike over operation on state highways. Economically, Bachman concluded, the construction of more turnpikes is a necessity. But methods of financing, by toll or by taxation, will require considerable study.

Cargo 'Copter Has Detachable Pod

• Dayton Section
T. L. Deger, Field Editor

Feb. 10—There has been greater progress made in the development and application of uses of the helicopter in the past ten years than in any other phase of aviation for the same period.

As to future progress, "the sky is the limit," claimed **Earl Woolery**, of the Piasecki Helicopter Corp., at the February meeting of the Dayton Section. Woolery holds a liaison position with Piasecki, operating between the engineering and manufacturing divisions and with the jobber.

Woolery told members of future military and commercial jobs for the helicopter, insofar as security would permit. He highlighted his talk with slides depicting the comparative advantages of the helicopter over other forms of transportation for distances ranging from 0 to 375 miles.

The chief future commercial use of the helicopter will be to transport goods in cargo truck lots, Woolery said. As depicted by the slides, this will be accomplished by a large cargo helicopter with a "pod" forming the main

The importance of style and design in the makeup of an automobile was explained by H. T. Bannister of Chrysler Corp. at the Feb. 23 meeting of Central Illinois Section. Left to right are: Section Chairman J. T. Liggett; H. T. Bannister; R. P. Van Zandt of Caterpillar, who as coffee speaker told about his hobby of astronomy; and S. L. Terry of Chrysler, technical chairman of the meeting

body section. This pod will be detachable and when detached will assume the make-up of a large highway cargo trailer. In this way the helicopter can be used to supplement the tractor of the highway cargo carrier whenever and wherever desired.

The best-known military uses of the 'copter are for air-sea rescue work, spotting, and the transportation of troops and other military personnel to inaccessible places.

Woolery concluded his presentation with a colored movie of the helicopter in action in the performance of its many uses.

Sound Styling Is Engineer's Salesman

• Central Illinois Section

R. B. Applegate, Field Editor

Feb 23—"Highly developed machines and materials never dreamed of in previous times have now become commonplace and have been integrated into our everyday living to such a degree that if they were suddenly removed, the world civilization would be thrown into chaos beyond comprehension." With this statement **H. T. Bannister**, stylist in charge of the De Soto Studios, Chrysler Corp., began his talk on "Styling as a Salesman."

Scientific development has provided the people of today with freedom of time—time to become better informed and broadened in scope. More people are spending more time at the theater, opera, concerts, and art museums. They are becoming aware of aesthetic values and demanding better appearance in the things they use in their everyday lives.

Interest in the arts and crafts has prevailed throughout the centuries in all civilization, but in the past only the ruling classes and the rich had the time to pursue these cultural interests. The development of machines and processes has changed all this, and where fifty years ago the average person was more interested in what a machine would do, today its technical quality is generally taken for granted and one of the prime considerations in the selection of one product over another is its appearance, its style and design.

The basis of good design is not craftsmanship or quality of material, nor is it an applied art in the form of decoration, color, or surface finish. All these play their parts, but the basis is functional efficiency and by this standard we find good design in articles of all ages.

Since the primary function of the automobile is to provide transportation, it should look as though it is intended to accommodate passengers comfortably as well as to travel on land. However, automobiles are purchased for other reasons and these must also be considered by the designer. It is these other factors that may give the designer his chief problems.

A product must have a new and distinctive look and yet convey a pronounced feeling of fitness for purpose. The designed shapes and forms must be constructionally sound and at the same time have regard for the materials and the production methods used. Good design is always harmonious, which is achieved by the proper blending of the elements so they strike a happy compromise between monotony and excessive contrast. Character is essential in good design; any properly designed article has a personality, a flare that satisfies the desire for individuality in one's personal possessions.

Good design should reflect the spirit of the age. Copying old designs is not making the most of new materials, new processes, and new techniques which allow the use of new forms, shapes and proportions to create a beauty that distinctively reflects the spirit of this age. Products must be pleasing to the eye of the consumer for styling to succeed as the engineer's salesman.

Bannister illustrated his remarks with lantern slides and with a beautiful color movie depicting the various aspects of automobile body design.

Sid Terry, stylist for color, finish and fabrics, De Soto Studios, Chrysler Corp., was technical chairman of the meeting and joined Bannister in answering questions.

A short business meeting was held at which Horatio W. Smith, manager of the industrial sales division, Caterpillar Tractor Co., was presented a certificate honoring him for his more than thirty-five years service to the SAE.

R. P. Van Zandt, research staff engineer, Caterpillar Tractor Co., was the coffee speaker, giving an interesting talk on his hobby, amateur astronomy.

Four Point Program For Better Maintenance

• Southern California Section

Peter Kyropoulos, Field Editor

Feb. 19—There's no one answer to vehicle maintenance, **Tom W. Lauer**, general service manager of the White Motor Co., told Section members and guests. Attention to each of four major areas that affect maintenance is necessary for improved fleet efficiency and lower costs.

The four points of a good maintenance program, Lauer said, are: (1), good driver relationships and cooperation; (2), proper preventive and repair procedures; (3) modern tools and equipment; and (4), cooperation of and with vehicle manufacturers.

Carefully trained drivers, who take pride in themselves and their machines, eliminate much trouble before it starts—and incidentally make for good public relations with motorists and others. Lauer emphasized the importance of assigning drivers to one machine, and of utilizing their intimate knowledge of the vehicle.

Preventive maintenance should take vehicle operation into consideration,

to avoid over- or under-servicing, which can seriously affect cost. Experience must guide in establishing inspection schedules and life expectancy of components and parts. Lauer gave an outline of White's experience with replacement periods of various units.

Repair facilities must accord with the size and concentration of the operation, and Lauer listed some equipment suitable for operations of various scales. To meet the problem of scattered fleets, many companies are turning to mobile "repair-shops-on-wheels," he said.

Cooperation with vehicle manufacturers is one of the best means to lower maintenance costs, Lauer concluded. Two heads are better than one—especially when they bring together intimate knowledge of vehicle capabilities and operating conditions.

Lauer's presence at the meeting represented a triumph of SAE determination. En route from Cleveland to attend the meeting, Lauer was delayed when his train was halted by a burnt bridge. Rather than arrange for a substitute speaker Richard Cochran, White branch manager in Los Angeles, arranged for a chartered plane to pick up Lauer and fly him to Los Angeles. Split-second timing resulted in Lauer's arrival at the meeting just as the chairman was rising to introduce him.

Ignitron Rectifier Improves Locomotive Power

• Williamsport Group

Paul Cervinsky, Field Editor

March 2—The successful tests and revenue runs made by the ignitron rectifier locomotive are evidence that a very valuable and important addition is available to the electrified railroads, stated **E. W. Ames** of the transportation engineering department of Westinghouse Electric Corp. before 60 members and guests of the Williamsport Group.

This locomotive became possible with the successful sealing of the rectifier tube which occurred in 1937 in unrelated electronic tube development work, said Ames.

Ames pointed out the following advantages of the ignitron locomotive:

1. Since single phase power is used, no voltage is present to reignite an arc-back. (This was a large drawback with the earlier 1914 rectifier railway car.)

2. Traction effort and smooth heavy pulling is available at all times.

3. Maintenance and overhaul problems are minimized.

4. Riding qualities excel all previous locomotives.

5. The ignitron locomotive operates satisfactorily on either 25 cycle or 60 cycle ac power.

6. With the cost of other energy rising, the ignitron locomotive becomes increasingly attractive.

In addition, the group was honored to have Robert Cass, president of SAE and John C. Hollis, manager of the Society's administrative division, as guests. Cass presented a short but timely message to the group.

Examines Performance Of Aircraft Turbojets

• Washington Section

Allen P. Blade, Field Editor

A. P. Blade

Feb. 17—"Aircraft Turbojet Engines" were reviewed and compared by **Addison M. Rothrock**, assistant director of research, National Advisory Committee for Aeronautics.

Rothrock first discussed briefly the fields of application of the reciprocating engine, the turboprop, turbojet, and ramjet, showing that, at speeds greater than that of sound, the turbojet is a reasonably efficient prime mover; but the greater drag of the airplane at high speeds results in ranges lower than those obtainable at subsonic speeds.

Graphs and curves were presented showing the effects of the main turbine engine and flight variables. Compressor compression ratio, turbine inlet temperature, aircraft speed, and altitude were related to the specific output and specific fuel consumption of the engine. The interrelation of the effects of compressor pressure ratio, turbine inlet temperature, and flight speed were emphasized. Translating these factors into terms of thrust and specific engine weight at altitude illustrated the manner in which the over-all performance of an engine is estimated. The effects of flight speed and altitude on stresses on the engine, and therefore on the engine weight, were brought out.

After these more general considerations, Rothrock treated research and development problems met in the endeavor to increase the performance of the turbojet engine. He pointed out that since most of the flying is done at high altitudes as well as high speeds, it is necessary to have altitude test facilities such as those at NACA's Lewis Flight Propulsion Laboratory and under construction at the Air Force laboratory at Tullahoma and the Navy laboratory at Trenton.

Consideration of the factors affecting performance of the compressor emphasizes the need for compressors with greater air handling ability and with fewer blades. In explaining combustion, Rothrock brought out the interrelation between altitude and combustor blow-out and the effect of molecular structure of the fuel components on flame speed. Turbine cooling and its application to the turboprop were discussed, showing that the successful application of turbine cooling to the engine would provide major increases in performance.

The relationship between those factors which affect one of the major engine components and those affecting the other major components were described.

Addison Rothrock has been with the National Advisory Committee for Aeronautics since 1926. After serving on the staffs of the Langley Aeronautical Laboratory at Langley Field, Va., and the Lewis Flight Propulsion Laboratory at Cleveland, Ohio, he was transferred to the headquarters staff in Washington in 1947.

Representatives of other governments were among the guests at the well-attended meeting.

Miniature Explosion Shows Gasoline Power

• Twin City Section

D. D. Hornbeck, Field Editor

Feb. 11—Only 12 drops of gasoline formed sufficient vapors to blow the paper roof off a model plastic tank at the Ethyl Corp.'s "Firepower" Show. More than 120 members and their wives saw **Joe Hopkins**, Ethyl's representative in charge of the show, lift a metal disc from a plastic plate and thereby generate enough static electricity to light a neon sign or to touch off a gasoline vapor explosion.

The Ethyl "Firepower" Show is one of five that has toured the country dramatizing the petroleum industry's safety program to gasoline refiners, transporters, and service station dealers. The show is an outgrowth of a series of lectures and demonstrations given by Ethyl Corp. during the war to teach the safe handling of gasoline to the armed services. During the past five years more than 1750 shows have been given before audiences totaling about 170,000 persons.

The creeping characteristics of gasoline vapors were demonstrated by Hopkins when he dropped a gasoline-soaked rag in a box to which was attached a long downward-sloping glass tube. He placed a cigarette lighter at the end of the tube and in a few seconds the vapors drifted down the tube, were ignited and carried the flames up to the rag.

"The average gasoline industry employee is safer while at work than in

Clevelanders take to TV

1. Last minute preparations for the TV program, including setting up of props like the Ford engine cutaway at right, are being made by (left to right) WNBK announcer Paul Bedford, TV Program Committee Chairman Ray Potter, and Walter Wilgus, SAE student branch chairman at Case Institute of Technology

2. Other engines shown on the TV show were a 1918 Cole (left) and an experimental "V," both rated at 100 hp. Discussing the powerplants are (left to right) J. M. Smith, announcer Paul Bedford, and Ray Potter

3. Watching automotive engineer S. G. Laughlin, of Leece-Neville, at work are announcer Bedford, Rose Schmidt (Rhodes High School student), and Al Gilchrist (partly hidden)

4. "Automotive engineers have replaced the old crank with a small button on the instrument panel so that women could drive cars," explains Ned Brown (center) to Miss Schmidt and Larry Simson

his home. Modern safety practices of the petroleum industry make gasoline as safe as any other commodity when it is handled properly and used as intended—for a motor fuel only," Hopkins concluded.

Cleveland Section Gives Television Show

• Cleveland Section

Feb. 8—Video viewers in Cleveland were treated to a half-hour afternoon program written and produced by the Cleveland Section. Entitled "Yesterday Meets Tomorrow," the program was designed to acquaint high school students with the various facets of automotive engineering.

The program was the fourteenth in a series called "Adventures in Engineering," sponsored by the Cleveland Technical Society.

The program started with Section Vice-Chairman Ned Brown telling two high school students, a boy and girl interested in automotive engineering, what goes on behind the scenes in designing and producing a motor car. A movie film as well as "live" props in the studio supplemented Brown's discussion. (See pictures at left for scenes at the studio.)

The committee responsible for the TV program was chairmanned by R. I. Potter. Serving with him were A. D. Gilchrist, E. K. Brown, J. E. Sterling, R. M. Cummings, J. C. Childs, and J. M. Smith.

Discusses Systems Of Unit Replacement

• New England Section

John W. Jacobsen, Field Editor

Nov. 6—**E. M. Lunda** presented an outline of the various unit replacement systems used by truck and bus fleet operators today. Lunda, assistant director of service for the Mack Mfg. Corp., first described the four basic systems: specified mileage replacement, condition replacement, combination replacement and failure replacement. He then discussed the pros and cons of each.

Best method, in Lunda's opinion, is the combination replacement system, which gives the advantages of replacing at a specified mileage according to

condition of the unit, and does away with the disadvantage and disorganization of the failure system ("run 'em till they drop out").

The satisfactory operation of any system, however, depends also on other vital factors, said Lunda. First is the operation of an efficient preventive maintenance inspection system. An adequate spare parts stock is also indispensable, and can be determined only by individual experience.

An analysis of road service calls leads to an indication of the units which can be replaced on the condition basis and those that would be preferable on a specified mileage basis. Figures on the average life of different types of units may also be obtained from such a study and will provide valuable information for the fleet maintenance supervisor with an eye to the future.

During the evening's program, which was directed by George T. Brown, Bus and Truck Activity chairman, John Chisholm of the Cosgrove Transportation Co. described current methods of manufacturing tank trailers and bodies, using the latest developments in light weight metal alloys.

First Hand Account Of Korean Helicopter Needs

• Philadelphia Section

J. A. Daley, Field Editor

Jan. 7—An eye-witness report on the performance of present helicopters and a prediction of future helicopter needs was presented at a joint meeting of the Philadelphia Sections of SAE and the Institute of the Aeronautical Sciences, chaired by Earl Stewart, an I.A.S. member and vice-chairman for aircraft of SAE's Philadelphia Section.

Harry S. Pack, vice-president of Piasecki Helicopter Corp., presented a comprehensive report on his recent personal survey of the use of military helicopters in the Korean theater. Pack defined the field of operations of the helicopter as used by the Army, Navy, Marines and Air Force.

The number of medical evacuations from the immediate combat area by the military services is amazingly high. Pack cited the terrific decrease in deaths from wounds, as compared to previous battle losses, because the wounded men could be delivered from the front lines to complete mobile Army service hospitals or to the Navy hospital ships off-shore, oftimes in less than one hour. It is very understandable why medical departments want more medical airlifts.

The use of helicopters for recovery of pilots downed behind enemy lines had been a very significant field of operation, though the increasing saturation of most all rear-area enemy territory has increased the hazard many fold. The rescue helicopter is often exposed to small arms fire for the round trip of as much as 75 miles. As Pack pointed out, the need for such pickup still exists, but the dangers to the recovery team must be reduced by the development of much higher speed craft.

The use of helicopters by the Marines for replacing units of battalion strength in the front lines was described. The advantages of flexibility that this would give a military commander accounts for the pressure now being exerted toward increasing the load-carrying capacity. The military demands appear to have centered on obtaining helicopters to fit three basic requirements:

1. The 3000-4000 lb general purpose machine.
2. The 8000-10,000 lb craft which has proved capable of supplying the

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basic needs of the battalion.

3. The 16,000-20,000 lb helicopter to provide a means of carrying by air what the 2½ ton truck can carry by road.

Pack's report was very well illustrated with color slides that he took on his trip. Many of the pictures were taken from helicopters on actual operational flights and several were taken while flying in one of the outrigged medical evacuation litters.

Outlines Factors In Modern Bearing Design

• Chicago Section

P. P. Polko, Field Editor

Feb. 10—More than 450 members and guests of the Chicago Section heard bearing engineer **Edwin Crankshaw** of the Cleveland Graphite Bronze Co. tell of the latest engineering technique in the bearing industry. The Section was treated to a pleasant social half-hour sponsored by Thompson Products, Inc. and the Cleveland Graphite Bronze Co.

Since the advent of pressure feed lubrication, the "PV" or "pressure times rubbing velocity" factor is seldom or never used in bearing requirement evaluations, Crankshaw stated. Bearing pressures have much to do with bearing problems, and, often, the pressure is the deciding factor in selection of type of material to be used. Moreover, bearing engineers have learned that the faster a shaft rotates the more effective will be the oil film, provided the amount of oil passed through the bearing is adequate.

The items considered in bearing design include oil film thickness, clearance, temperature rise through the bearing, viscosity change due to temperature rise, and the length-diameter ratio (L/D) which greatly affects running eccentricity. The calculation of forces occurring on engine bearings is the starting point in bearing design. Gas forces, reciprocating inertia forces, and rotating inertia forces are combined vectorially and plotted on polar diagram.

When evaluation of load is made at various positions of a crank arm, a typical connecting rod bearing load diagram can be constructed. This diagram shows the magnitude and direction of the load throughout one cycle and permits determination of oil groove and mud pocket design as well as location of oil hole in crank pin.

The rapid development of the present day high-speed high-output engine has placed increasing importance on the realization of the lowest possible temperature rise in the bearing. High temperatures caused by low clearance and insufficient oil flow have several bad effects on bearing performance, and among these is rapid reduction in fatigue life of the bearing material. The combination of increased loads and relatively higher temperatures and the resulting lower oil viscosity decreases the minimum oil film thickness and film strength. With high operating temperature it is necessary to have the ultimate in bearing-to-bearing alignment, minimum shaft distortion, and minimum taper in the bearing housing bore and on the journal surface.

One device often used to reduce bearing temperatures is the eccentric bearing in which the horizontal clearance exceeds the vertical, particularly in cases where the vertical clearance must be held to minimum to eliminate noise.

Lowest possible oil temperatures can be attained by providing for rapid removal of frictional heat generated in the bearing and incorporating design features to increase oil flow through the bearing. The addition of spreader grooves with chamfers from each end

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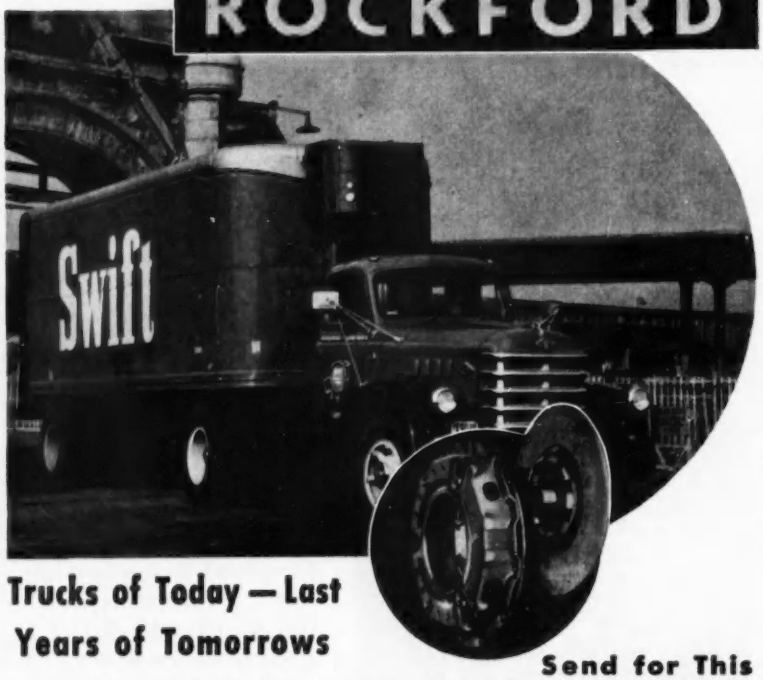

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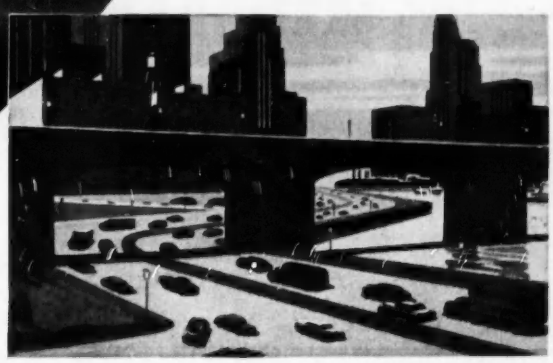
Today's higher-powered engines, with the need for faster starts and quicker stops, are imposing new and extra loads on automotive bearings. Keeping pace with these needs are Hyatt Roller Bearings. Preferred by leading automotive manufacturers since the industry began, Hyatts are still leading the way—meeting these greater demands with advanced methods of manufacturing, modern heat treatment and rigid inspection from raw materials to finished bearings. As a result, Hyatts virtually eliminate friction, reduce wear. They need a minimum amount of attention. And they provide longer life. There's a size and type for every automotive application. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Detroit, Mich.



HYATT ROLLER BEARINGS

of the groove to the end of the bearing, or parting line chamfers where spreader grooves are not used, aid in reducing bearing temperature.

To insure that sufficient lubricant is available for satisfactory engine performance, oil flow calculations are made for each bearing. How this flow is altered and influenced by the size and location of grooves, oil holes, and mud pockets, is taken into consideration. Oil grooves and drillings are designed to provide for the lowest pressure drop through the system.

No matter how well bearings are made, the longest operating life cannot be obtained if the engine in which they run is not clean. The need for cleanliness cannot be overemphasized, since the lubricating oil supplied to the bearings may be the very means of introducing wear-producing materials. To eliminate this possibility, it is necessary to make certain that only clean oil is circulated. This means the oil filter and air cleaner must be efficiently maintained. Modern bearings, having thinner linings, will not handle as much foreign material imbedded in the bearing liner, so that clean oil is important.

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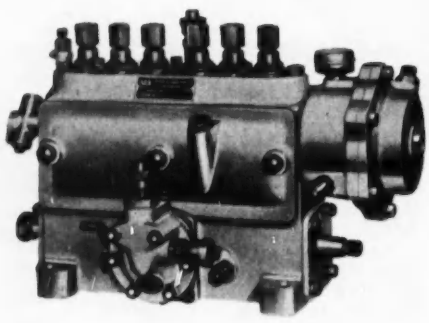

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Explains Method Of Carburetor Adjustment

• Milwaukee Section

Phillip S. Myers, Field Editor

March 6—**H. G. Bolton** of Marvel-Schebler Products Division, Borg-Warner Corp., discussed the function and operation of carburetors to a crowd of about 200 at the March meeting.

Bolton pointed out that the sole function of a carburetor is to provide the desired air-fuel ratio under all speed-load operating conditions.

In explaining the steps taken to "fit" a carburetor to a particular engine, Bolton said that the proper carburetor venturi is selected by trial and error to give the minimum decrease in horsepower with sufficient pressure drop to give good metering.

Following the selection of the venturi, full-load ability curves showing specific fuel consumption versus horsepower at different but constant engine rpm are obtained by varying the air-fuel ratio. Arbitrarily selected points, chosen as a compromise between best economy and best power, are placed on each of the resulting family of curves, and a full-throttle requirement curve is drawn through these points. A similar family of curves is obtained at constant speed but different throttle settings and the part-load requirement curve is obtained.

When the idle adjustment has been checked the carburetor is field-tested on an engine and changes, if necessary, are made to provide good field service. Following this field check the carburetor is checked on a carburetor flow bench and the data plotted as pounds of fuel per hundred pounds of air versus air flow. Two curves are obtained—one for part throttle and one for full throttle. Flow bench data from the pilot carburetor permit adjustment of production carburetors to deliver the experimentally best flow rate.

Bolton then explained the adjustments and items in the carburetor that are used to obtain the desired characteristics. The idle discharge is located near and on the low pressure side of the throttle valve. A secondary idle orifice, located just on the high pressure side of the closed throttle plate, aids idling and gives a smooth transition to the economy range. Full throttle fuel is supplied by the main nozzle whose flow is controlled not only by the venturi air pressure but by air bleeds as well. The economy portion of the curve is obtained by reducing slightly the air pressure on the fuel in the float chamber. A choke to provide a rich mixture for starting completes the required items.

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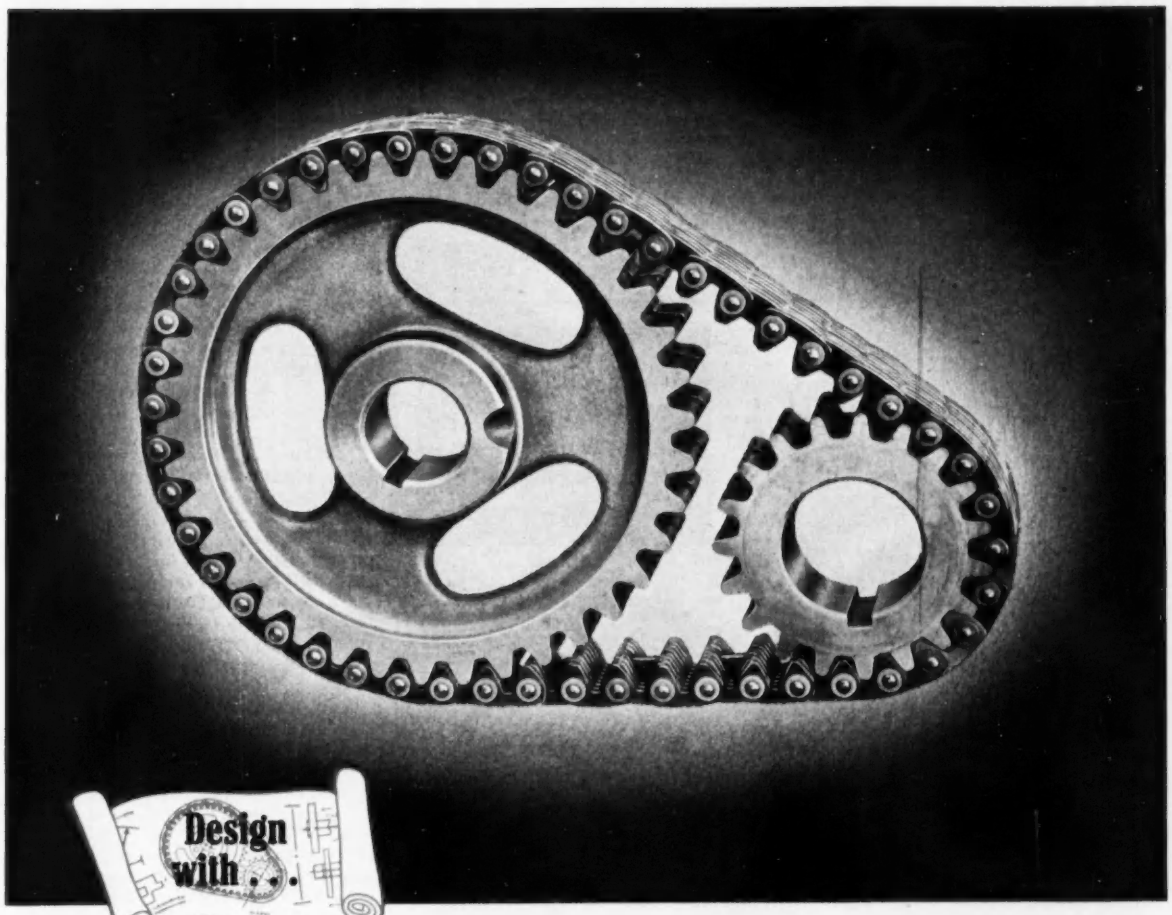

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riod, Bolton said that dirty air can clog jets and change the carburetor calibration. He also commented that he has not seen jets sufficiently worn by fuel erosion to require replacement. It was brought out that the carburetors under discussion will operate at an angle of 35–40 deg in any direction and as high as 50 deg in three directions. In reply to a question about the venturi, Bolton said that the outlet angle is the most important and that the positioning of the nozzle is especially critical if placed ahead of the throat.

Racing Car Design Takes Art and Skill

• Mohawk-Hudson Group

Knud Antonsen, Field Editor

March 3—**Robert T. Jackson**, Sales Engineer, Perfect Circle Corp., gave an informative and entertaining talk on "Indianapolis Racing Car Design" before a gathering of about 150 members and guests of the Mohawk-Hudson Group.

Drawing on his twenty years of experience in the design, construction and maintenance of racing cars, Jackson gave his audience a complete account of the requirements which must now be met before a racing car can compete in the historic 500 mile Memorial Day race.

His treatment of the subject was enhanced by a series of magnificent color slides made from photographs taken by Jackson at Indianapolis.

After a brief description of the layout of the Indianapolis Motor Speedway, aided by excellent aerial views in color, the speaker gave a detailed description of the Meyer-Drake 4-cylinder type 270 engine which in its basic execution, and with a number of variations, is used in the majority of cars competing at Indianapolis these days. Engine components and groups of components were illustrated with colored slides and their functions explained, design considerations involved were described and materials employed were stated.

Design of a racing car engine calls for practical common sense and a considerable degree of artistry, as well as fluency with a slide rule, Jackson said.

After covering the design and construction of the engine itself, Jackson described in detail the accessory equipment such as carburetors and fuel injection; he also gave a rundown on the various fuels employed and mentioned the trend towards power-boosting additives.

The design of transmission, suspension and brakes, and various frame and body constructions was covered in great detail, again illustrated by beautiful colored slides. Following his talk, Jackson showed a sound color film entitled "The Fabulous 500", which showed pre-race activities and then the 1952 Memorial Day Race itself.

Jackson was suffering from a severe cold and in consideration of this, it was decided to eliminate the usual discussion from the floor; but Jackson generously consented to answer any questions informally after the adjournment of the meeting.

Arthur M. Brenneke, chief engineer of the Manufacturers' Equipment Division of Perfect Circle Corp., accompanied Jackson.

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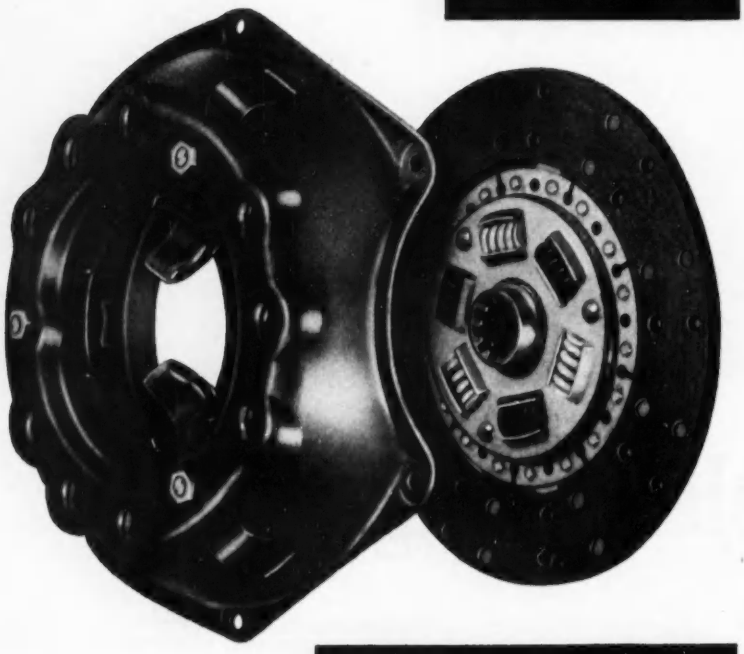

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Jet Temperatures Challenge Metallurgists

• Detroit Section

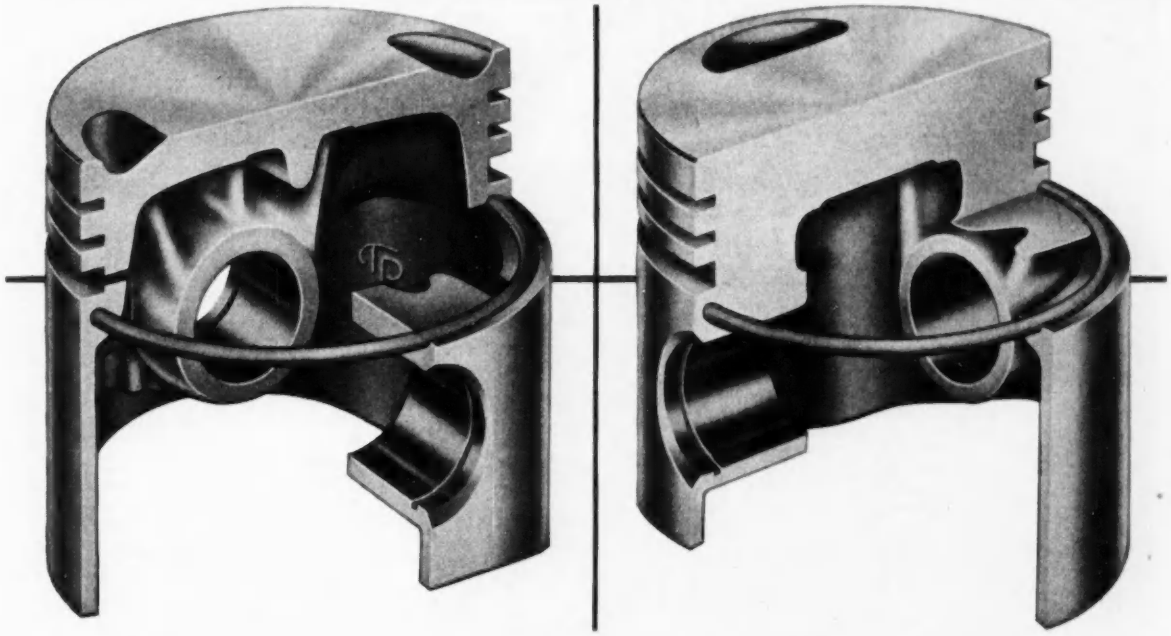
W. F. Sherman, Field Editor

Feb. 2—Jet engine material and production problems are no greater in number than those of conventional engines—but it is an entirely different set of problems, speakers told members of the Detroit Section.

R. E. Small, project manager, and

Another First—by Thompson

STEEL-BELTED PISTONS



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R. B. Johnson, engineer of the plant laboratory at the General Electric Aircraft Gas Turbine Division, teamed together to tell the story of manufacturing and metallurgical aspects of the J-47 program.

Small described progress in production which has led to the point where new engines are given only one test run, instead of the two test runs normally employed. This improved method of engine testing, obviously the end product of an excellent quality control system, saves more than 1000 gal of fuel per engine and eliminates operations involving disassembly, inspection and re-building. Normally, testing procedure requires a green run, plus a final run on each engine.

The GE procedure starts out using the dual runs on a group of 125 engines and permits dropping to successively smaller samplings if the initial group and others show a minimum rate of defects.

Small said, "In a production program as large as that for the J-47 it would be expected that many design changes to improve producibility for quantity production would be made. In a program this large it has also been necessary to develop more than one method for fabricating a given part."

He cited various processes for making stator blades, changes in assembly from the horizontal position to a vertical position to permit more accurate alignment, less production line congestion and greater assemby accessibility. Three engines can be assembled now in the space previously required for two engines, he said.

"Designers would like to operate certain parts of the jet engine at temperatures of 3500 F or higher, but materials are not available for such performance," Johnson said. He illustrated his talk with diagrams showing typical temperatures of air and gas and metal in certain parts of the jet engine. The inlet air temperature at 30,000 ft altitude is -60 F, the burning gas temperature is more than 3500 F, but metal temperatures are kept at levels below 1600-1800 F, he demonstrated.

"If we were designing a turbine bucket to operate at room temperature, the prime consideration would be the tensile and yield strength," he pointed out. "The yield strength would be the governing factor if plastic flow could not be tolerated. But if the temperature was increased to a level near the recrystallization temperature and the stress was high enough, the material would exhibit plastic flow or creep at temperatures considerably below the yield strength. . . . In the jet engine business the designer is interested chiefly in stress to rupture or in total creep rather than creep rate.

"The jet engine designer pushes on in his quest for higher temperatures. He can solve this material problem either through new alloys with higher temperature properties or by introducing air cooling systems which are not only difficult to design and build, but reduce the engine efficiency. His preference, therefore, is to have a material that is strong enough at higher and higher temperatures to meet his needs.

"The future thus is cut out for metallurgy in the gas turbine business. The designer can apply to good advantage almost any advance in high-temperature strength over and above the level we now are using. The faster we fly the hotter it gets and thus the metallurgist has one of the keys to a successful trip to the moon," Johnson concluded.

To "check out" the technical speakers, the committee invited an engineering test pilot to discuss his professional approach to the problem of experimental flying. This speaker was Phillip W. Houghton of McDonnell

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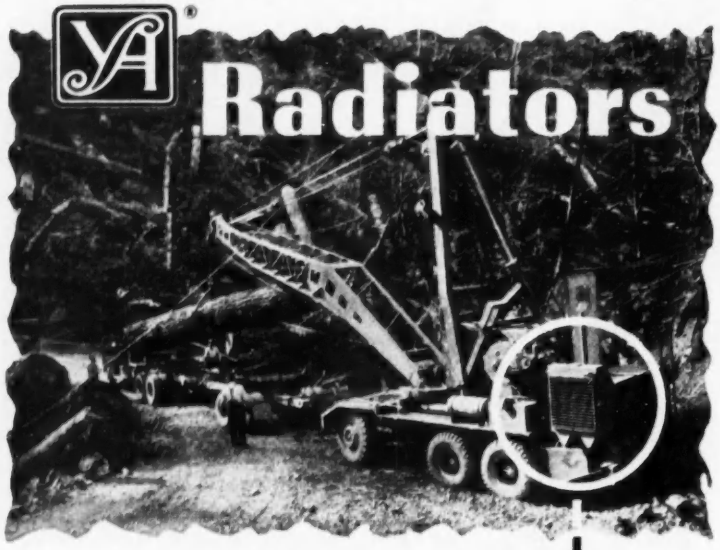

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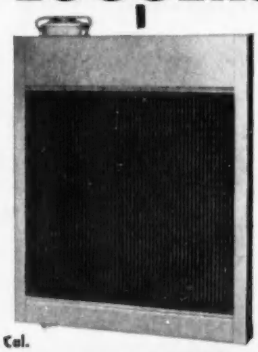

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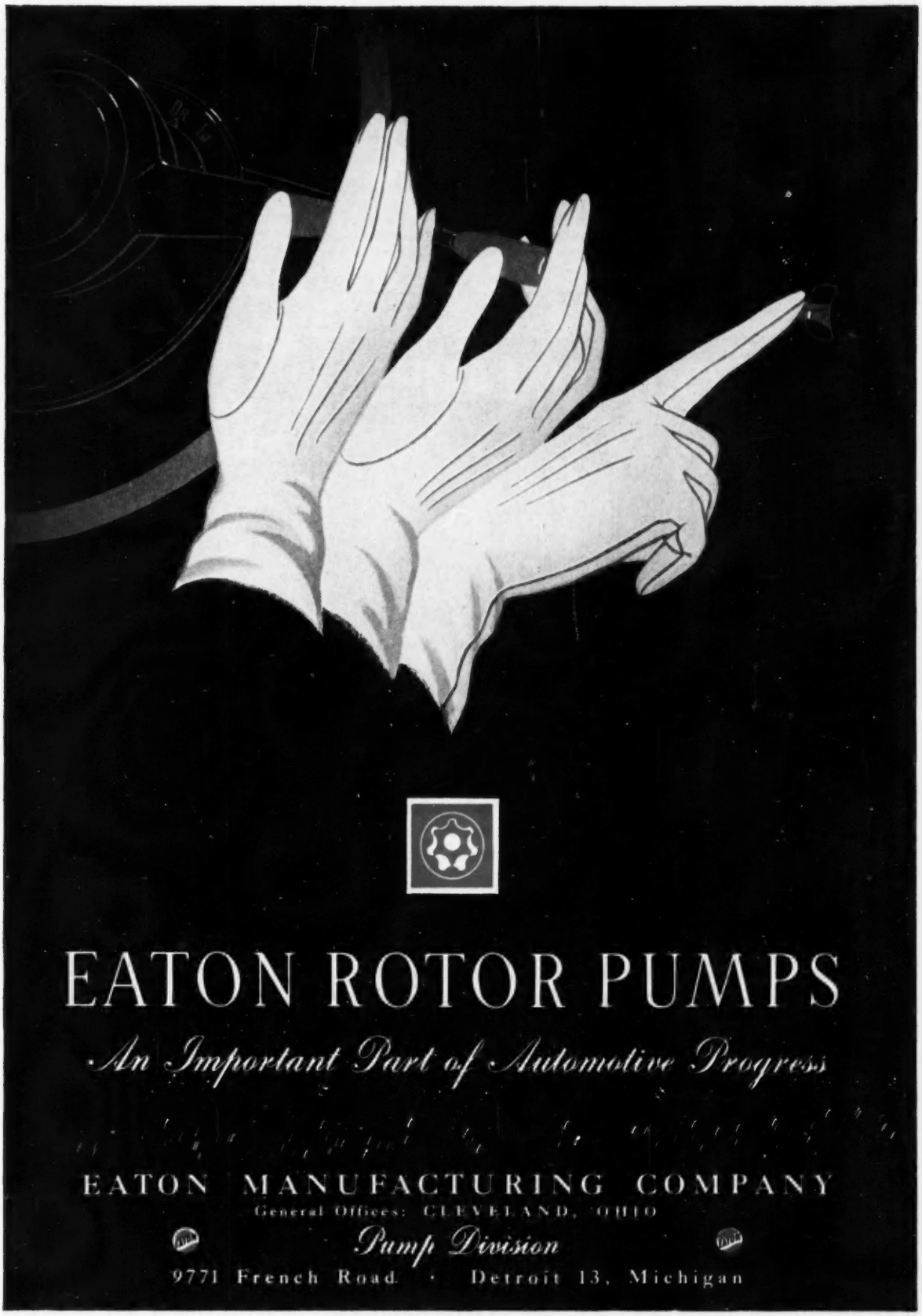
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Aircraft Corp. He described modern methods of recording data and the test procedures, which start out with taxi flights to determine brake performance because even the fighter plane weight is such that stopping in the length of the runway is a critical factor. His talk was enlivened with some of his personal experiences in test flying and he said that the sonic barrier is no barrier at all if an airplane is well designed.

Sees Bright Future For Jet Transportation

• Metropolitan Section

S. G. Tilden, Jr., Field Editor

March 5—"In one step the jet transport has increased by two-thirds the total speed increase for the last 25 years of transport operation," **John G. Borger**, chief project engineer of Pan American World Airways, told the Metropolitan Section in his paper "Meeting the Jet Transport Challenge."

"Developments in reciprocating engines have run their course, except for minor improvements," he continued. "The jet is here and here to stay."

Borger proceeded to explain to 135 members and guests Pan American's interest in the British-made de Haviland Comet jet transport. "The British," he said, "have their aircraft in operation today." Mockups and symposiums cannot replace the experience to be gained by actual operation of a few units.

"The de Haviland Comet," he said, "has a cruising speed of 500 mph." It is powered by four Rolls Royce jet engines, each developing 9000 lb thrust. It will carry 60 passengers in regular service, or 78 passengers in tourist arrangement, with full baggage and mail. The fuel capacity is 9700 U. S. gallons, giving it a 145,000 lb gross take-off weight. This airplane will cruise at 37,000 to 40,000 ft, with cabin pressurization maintained at 8000 ft. It is manned by a basic crew of three, with two passenger attendants.

Using a typical San Francisco to Honolulu run as a comparative example of fuel operating costs, Borger said that a DC-6B would make such a trip in 9 hours and 15 minutes, a DC-7 in 8 hours and a Comet in 6 hours. For the round trip, the DC-6B would use 7,140 gal of fuel, the DC-7 would use 7,520 gal, and the Comet 14,700 gal. Costwise, however, the high octane fuel for the first two costs 20.5¢ per gallon, whereas light diesel fuel for the Comet costs only 12.5¢.

From these data, Borger showed that the 7% increase in speed of the DC-7 over the DC-6B was done at a 5% increase in cost, while the Comet netted a 45% increase in speed from a 22% increase in cost.

Speaking of the future, Borger concluded by outlining five points where improvement is needed:

1. The newer jets must be faster.

2. They must have greater seating capacity.

3. They must be more flexible in passenger space design.

4. They must be reduced in initial purchase price.

5. They must have greater range.

In a discussion of the paper M. G. Beard, chief engineer of American Airlines, mentioned a problem of jet transport design that is foreign to past design concepts. "The powerplant," he said, "has always been the limiting feature of design." When more powerful engines became available they could be adapted to existing airframe

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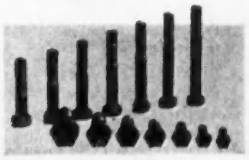

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designs. "In the jet transport, the wing controls the speed, not the engine. Thus," he concluded, "the airframe becomes obsolete at the same time the engine does."

Charles Froesch, in his discussion of the paper, affirmed that the industry is on the threshold of many new developments. As vice-president in charge of engineering for Eastern Airlines, he called for maximum safety in jet transport and for a reduction in operating costs, both in the initial purchase price and in the direct maintenance costs.

Tells Joint Meeting About Hydraulic Steering

• St. Louis Section

E. E. Wallace, Field Editor

Feb. 5—St. Louis Section joined with the Engineer's Club of St. Louis to hear **C. W. Lincoln**, chief engineer of the Saginaw Steering Gear Division of GMC, present his paper on "Power Steering in General Motors Cars."

Lincoln pointed out that cars have been growing heavier, particularly the front end, and that improvements in manual steering by means of higher ratios and reduced friction losses have approached the limit. Any appreciable additional improvements must come from providing power.

This situation was first reached on the large off-the-road equipment where some form of steering assist has been used for the last twenty years or so. Development has continued on hydraulic power steering means, proving successful on military vehicles in World War II, and has finally reached the passenger car field in the last few years as part of a trend toward easier, safer driving. This trend has included the wide-spread introduction and acceptance of allied devices such as automatic transmissions and power braking.

The principles of operation and the construction of the Saginaw hydraulic power steering gear were explained by Lincoln. He pointed out that in the Saginaw system, a natural road "feel" is retained by having a steering wheel rim pull of about three pounds needed before balancing springs in the valve are overcome and the power is utilized. As steering forces increase, higher hydraulic pressures are employed which, by means of reaction on balancing plungers in the valve housing, tend to open the valve exhaust ports and thus give an always proportional, but greatly reduced, steering effort.

Lincoln also pointed out that Saginaw engineers have felt that approximately the same steering ratios should be retained with power steering as with manual steering in the initial application to passenger cars, to avoid the need for driver training and familiarization. As power steering becomes more general, a gradual reduction in steering ratios is probable.

A summary of the various types of power-steering gears available to the motoring public and the design philosophies and characteristics of each closed Lincoln's talk.

Questions asked during an open discussion period indicated the intense interest in the subject and the enthusiastic reception of Lincoln's presentation.

Following the technical portion of the program, Engineer's Club and SAE members joined together for refreshments in the Club's social rooms.

On Feb. 2, St. Louis Section repeated last year's highly successful theatre party. A large number of the Section's members with their wives and guests attended a private showing of G. B. Shaw's "The Devil's Disciple" presented by the Community Players at Maryville College Auditorium.

Sponsors presented each arriving lady guest with camellias. Following the play, the group moved on to the Black Forest where an after-theatre buffet supper and refreshments provided the crowning touches to a most enjoyable evening.

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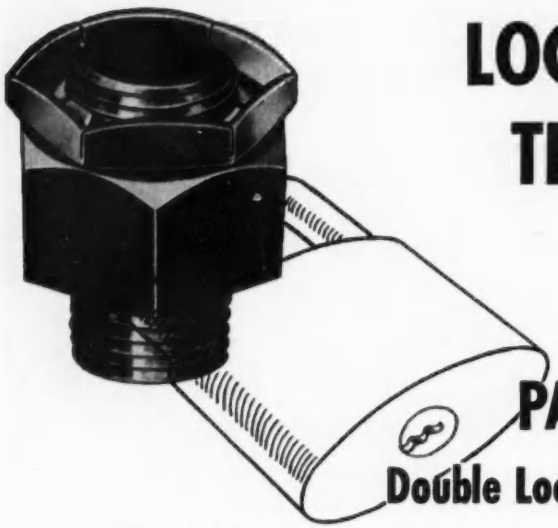

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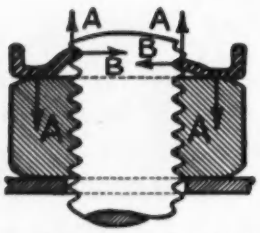

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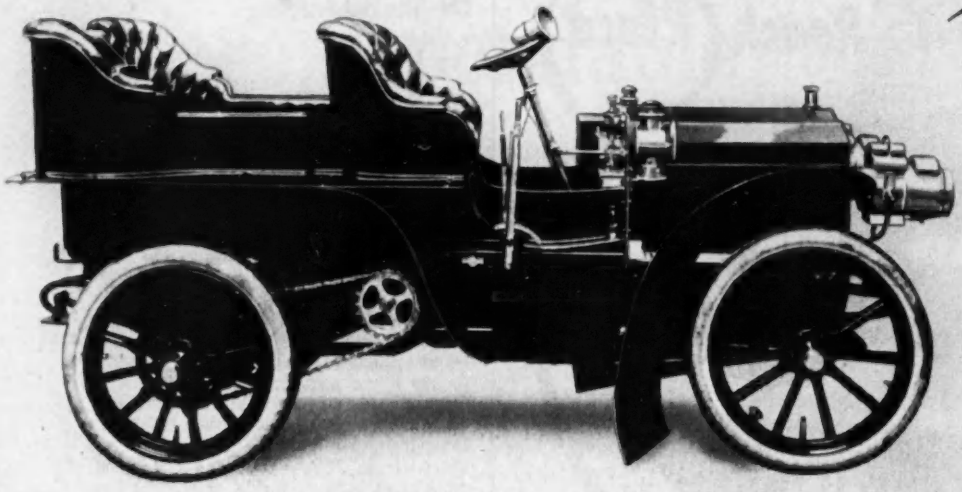

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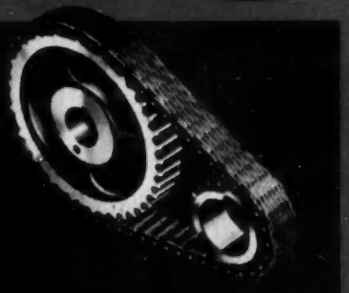

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Techniques Of Shell Molding

• Milwaukee Section
P. S. Myers, Field Editor

Feb. 6—**Wilbur S. Walters** of LaGrange Shell Molders, Inc., gave a very interesting talk on techniques used in shell molding, design considerations required, and the results that can be obtained. The interest and enthusiasm of the audience of about 150 was clearly shown in the question and answer period.

Walters said that the shell molding process, originated in Germany, involves placing a heated pattern (425 to 500 F) in a dump box filled with a mixture of sand and heat-curing resins and inverting the dump box so that the sand-resin mixture falls upon the hot pattern. The combination of heat, resin and sand deposits a coating or shell mold around the pattern which is cured in an oven and stripped from the pattern. The two halves of the mold are then held together by bolts or paste, or backed by steel shot.

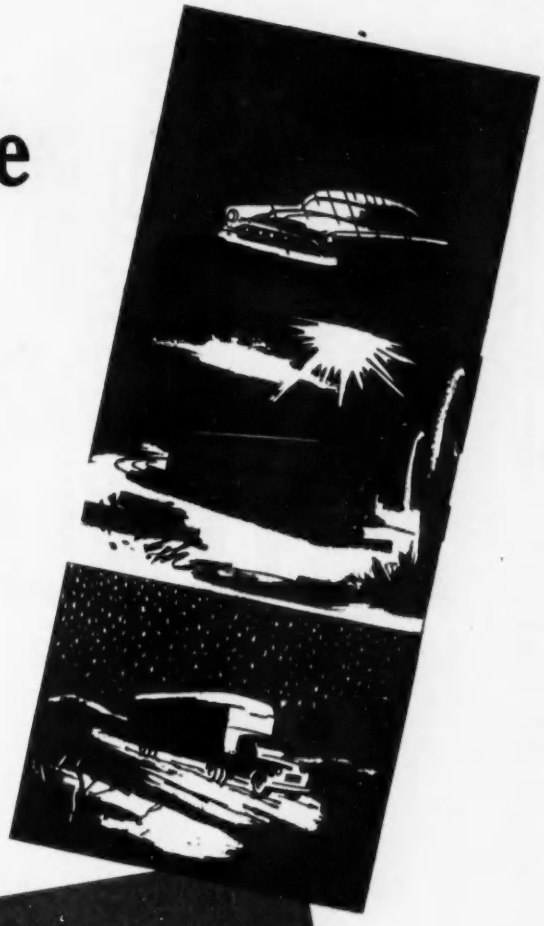
The use of the shell molding process improves working conditions, lightens molds so that women can be used as machine operators, minimizes ventilating problems, and increase general cleanliness.

Walters pointed out that from a cost standpoint shell molding may cost more per rough casting but, when consideration is given to machining costs and scrap, the finished product usually cost less. When patterns are properly designed scrap can be held to 0.1% to 1%; the castings are uniform in weight and size, being normally dimensionally accurate to .005 in. per inch of casting, with many dimensions held to .001 in. Furthermore, when using cast iron there is no chilling effect on the surface resulting in a hard layer, and cuts of only a few thousandths of an inch can be taken without excessive tool wear, Walters stated. Cost of shell molds can be reduced by use of fully automatic single station molding machines producing from 300 to 400 molds per eight hour day.

Pattern engineering is very important, Walters declared. The material used should have adequate strength at the temperatures involved, be of a dense material, and have a good thermal conductivity. Aluminum has not proved successful for long production run patterns; but low-expansion cast iron, "non-shrink" steel, grey iron, and high copper content materials have all been successfully used for patterns. Among the metals currently being cast are grey, cast, modular, ductile, and malleable irons; low carbon, high alloy, high chrome alloy; 304 and 316 stainless steel; aluminum magnesium, and low leaded and ten bronze.

Walters said that shell casting is peculiarly well suited to castings where

more dependable starting *under all operating conditions*



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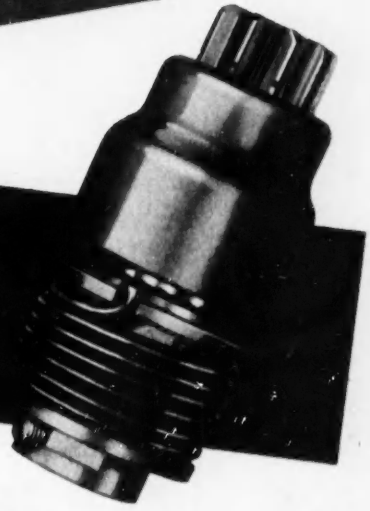

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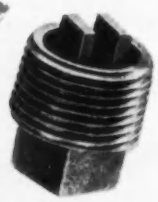
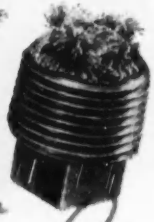


TO REMOVE IRON AND STEEL PARTICLES FROM OIL



WRITE for FREE sample plugs for testing. Just state size and type of plug desired.

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machine costs are high and where many machine operations can be eliminated. He showed samples of shell molding, including a water pump impeller needing shaft reaming only, and pulleys needing shaft reaming only. When smooth surface finishes are desired, where intricate detail is required, and where intricate core work is necessary, shell molding may produce appreciable savings.

Valve Design A Tricky Affair

• Indiana Section

V. H. Lewis, Field Editor

V. H. Lewis

Feb. 12—"Valve design has gimmicks" was the provocative expression used by **Vincent Ayres**, assistant chief engineer on valve gear for Eaton Mfg. Co., in presenting his paper "Valves and Valve Gear Problems." Design and the service problems affecting design of the entire engine valve train were covered by discussing each part of the valve train separately.

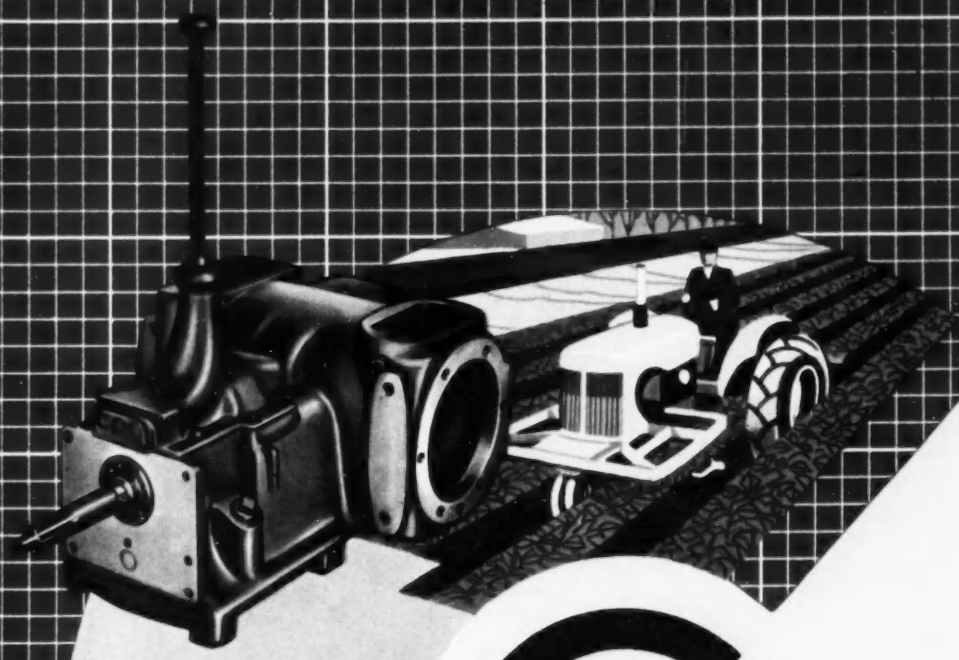
Material is a big factor in satisfactory valve design. Inlet valve material ranges from low alloy iron to silichrome, while exhaust valve material starts with the use of silichrome and progresses on to Austenitic alloys.

In general, valve material ranges from 95% iron for inlets to 95% alloy for exhausts.

In discussing valve keeper design, Ayres pointed out that provision for valve rotation is the "gimmick" in engine design that prolongs valve life. One of the most popular methods of obtaining rotation is the removal of cam thrust from the stem, permitting the valve to dance around while it is off the seat.

The significant feature of good port design is locating the guide flush port contour so as to provide maximum cooling and heat dissipation. Although this is a big factor in reducing valve sticking tendencies, coating or roughing the valve stem to provide better oil distribution is an additional improvement.

Valve seat inserts and tappets were discussed, along with hydraulic lifters. Ayres pointed out that hydraulic lifters were first used by Pierce-Arrow in 1930; by 1950, sixteen different automobile engines were so equipped. The three most plaguing problems in lifter operations are foreign particles, condition of the oil, and oil aeration. Sharp or abrupt cam contours also affect hydraulic lifter operation adversely, because they create valve bounce that causes lifters to "pump up," reducing the lash to zero and causing valves to be held open.



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Students Enter Industry

DONALD Y. DAWSON (Oklahoma A & M College '52) is supervisor of production planning at the Joplin, Mo., division of Vickers, Inc.

RODERIC C. SOWELL (Cal-Aero Technical Institute '52) is a junior engineer for Boeing Airplane Co., Seattle, Wash.

DAVID PATERSON, JR. (Lawrence Institute of Technology '51) is a captain in the U. S. Air Force.

JOSEPH J. FOYST (Purdue University '52) is in training with Cummins Engine Co., Columbus, Ind.

ANTHONY W. MAGULA (University of Southern California '52) is a research analyst for North American Aviation, Inc., Downey, Calif.

HERBERT W. BEHLOW (General Motors Institute) is now serving in the U. S. Army.

MICHAEL H. KLEINMAN (New York University '52) is a laboratory engineer in the engine development laboratory of Chrysler Corp., Highland Park, Mich.

WALTER A. GILLIS (West Coast University '52) has joined the Sperry Gyroscope Co., Great Neck, N. Y., as field service engineer.

ROBERT E. FIELD (Cal-Aero Technical Institute '51) is a flight test analyst in the powerplant group of North American Aviation, Inc., Los Angeles, Calif.

LEO P. DUFFY (New York University '52) is a petroleum engineer for Shell Oil Co. at the Norco, La., refinery.

MICHAEL J. KLEINMAN (New York University '52)is a laboratory engineer for Chrysler Corp., Highland Park, Mich.

DALE C. GREIG (Case Institute of Technology '52) is with the quality control department of Euclid Road Machinery Co., Euclid, Ohio.

ALAN C. BARKER (California State Polytechnic College '51) is now in the U. S. Navy.

MANFRED HOLDER (Ohio State University '52) is a mechanical engineer with A. E. Holder and Associates, Cleveland, Ohio.

ELMER D. KING (California State Polytechnic College '52) has joined Oxnard Heavy Maintenance and Mfg. Co., Oxnard, Calif., as design engineer.

JOHN E. KEANE (Manhattan College) is a project engineer for Radiomarine Corp. of America, New York City, while

Methods,

process engineers . . .

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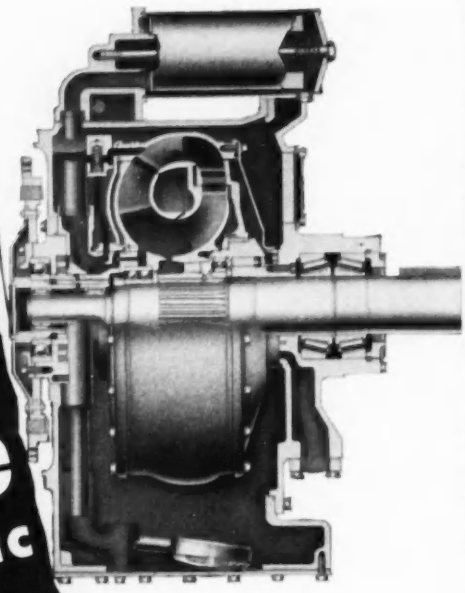

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Students Enter Industry

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continuing his studies at the night school of Newark College of Engineering.

JULIO MELGAR (University of Detroit '52) is a liaison engineer for Chance-Vought Aircraft Division of United Aircraft Corp., Dallas, Texas.

TED DEL SOLAR (Michigan State College '51) is a product tester for the farm tractor engineering department of International Harvester Co., Chicago.

OSCAR A. LEVI (Purdue University '52) is a junior flight research engineer with Sikorsky Aircraft Division of United Aircraft Corp., Bridgeport, Conn.

WILLIAM H. DEVENPORT (Cal-Aero Technical Institute '52) is a draftsman for the Pacific division of Bendix Aviation Corp., North Hollywood, Calif.

ELLARD D. DAVISON, JR. (Michigan State College '51) is with Snyder Tool and Engineering Co., Detroit, as a mechanical engineer.

ROBERT CRAVER (Tri-State College '51) is an inspection foreman on spark plug insulators for A. C. Spark Plug Division of General Motors Corp., Flint, Mich.

PARKER B. CREEP (Pennsylvania State College '52) is an industrial engineer at the Fairless Works of United States Steel Corp., Morrisville, Pa.

JACKSON G. BYERS (Purdue University '47; University of Michigan '50) has returned to GMC's Pontiac Motor Division as automotive engineer after a year and a half of military service.

DONALD M. MULLINGS (University of Pittsburgh '52) is now a second lieutenant in the Corps of Engineers at Fort Belvoir, Va.

RONALD J. SAVAGE (Illinois Institute of Technology '52) is now with Chrysler Corp.'s jet engine division, Warren, Mich.

THEODORE H. OGLESBY (Washington State College '52) has joined Lockheed Aircraft Corp., Burbank, Calif.

ALBERT C. CHING (University of Connecticut '51) is an analytical engineer for Pratt and Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn.

STEPHEN H. ACHTENHAGEN (University of Colorado '52) is now administrative assistant engineer with the reviews and replacements section of

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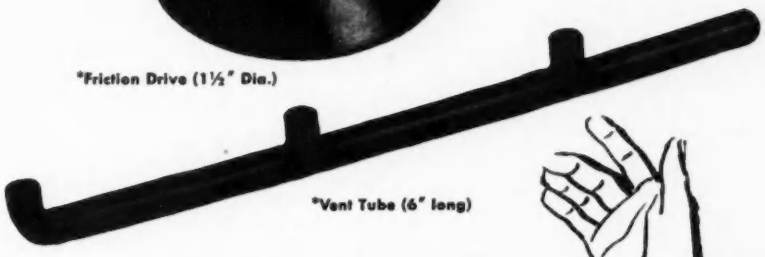

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engineering manpower control at Lockheed Aircraft Corp., Burbank, Calif.

DALJIT S. JAMWALL (Yale University '52) is now a mechanical engineer for the Aluminum Co. of Canada, Kingston, Ont. Jamwall plans eventually to transfer to the Indian Aluminum Co. in Calcutta, India.

JAMES T. RUDIE (Parks College '52) is now a second lieutenant at Keesler Air Force Base, Miss.

SIDNEY F. SEGAL (University of Detroit '51) is a second lieutenant in the Air Force and project engineer at Wright Air Development Center, Dayton, Ohio.

EVERETT W. BUDD (Illinois Institute of Technology '52) is with the Ordnance Division of the George D. Roder Corp., Rockford, Ill.

T. R. DICK (Bradley University '52) has joined the Columbus, Ohio, division of North American Aviation, Inc., as engineering draftsman.

OLIVER L. GRIMES (Oregon State College '52) is in Dhahran, Saudi Arabia, as an automotive engineer in training with Arabian American Oil Co.

EWALD R. DIEMER (University of Illinois '52) is a junior flight test instrumentation engineer with Chance-Vought Aircraft Division of United Aircraft Corp., Dallas, Texas.

MALCOLM B. SWIMLEY (Northrop Aeronautical Institute '52) is a junior engineer with Consolidated Vultee Aircraft Corp., Pomona, Calif.

DONALD S. CROW (Indiana Technical College '51) is a service representative for Cummins Engine Co., Inc., Columbus, Ind.

JAMES H. WINTERS, JR., (California State Polytechnic College '52) is now an engineering drawing checker for Northrop Aircraft, Inc., Hawthorne, Calif.

LOREN A. SCHEELE (University of Colorado '52) is a heating and ventilating analyst for North American Aviation, Inc., Los Angeles, Calif.

ERVIN PENKALSKI (University of Wisconsin '52) is with GMC's AC Spark Plug Division, Milwaukee, Wis., as field service engineer.

EDWARD F. WILK (University of Massachusetts '52) is with Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn., as a test engineer.

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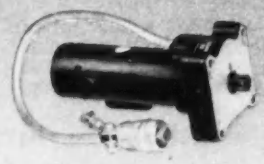

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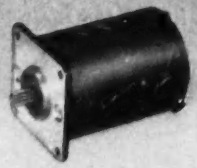

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Let's Stop Selling Horsepower to Public

Based on paper by

E. J. HORTON
Ford Motor Co.

WE have educated the public to believe horsepower to be the item in an engine and, in some instances, in the whole automobile. If we continue to encourage the public to demand horsepower and speed, we will surely end up with legislative action to limit maximum speed and thus create a different trend in engine design.

With today's driving conditions, the success of a car, performance-wise, is to be measured more by the way the engine characteristics are harnessed to provide a good speed for steady driving, flexibility, and economy, rather than maximum speed. Transmissions and rear axles should be adopted that will fully utilize the range of reasonably high torque rather than try to obtain the highest possible road speeds. (Paper, "Let's Look Beyond Horsepower," was presented at SAE Junior Activity Section, Detroit, Oct. 20, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

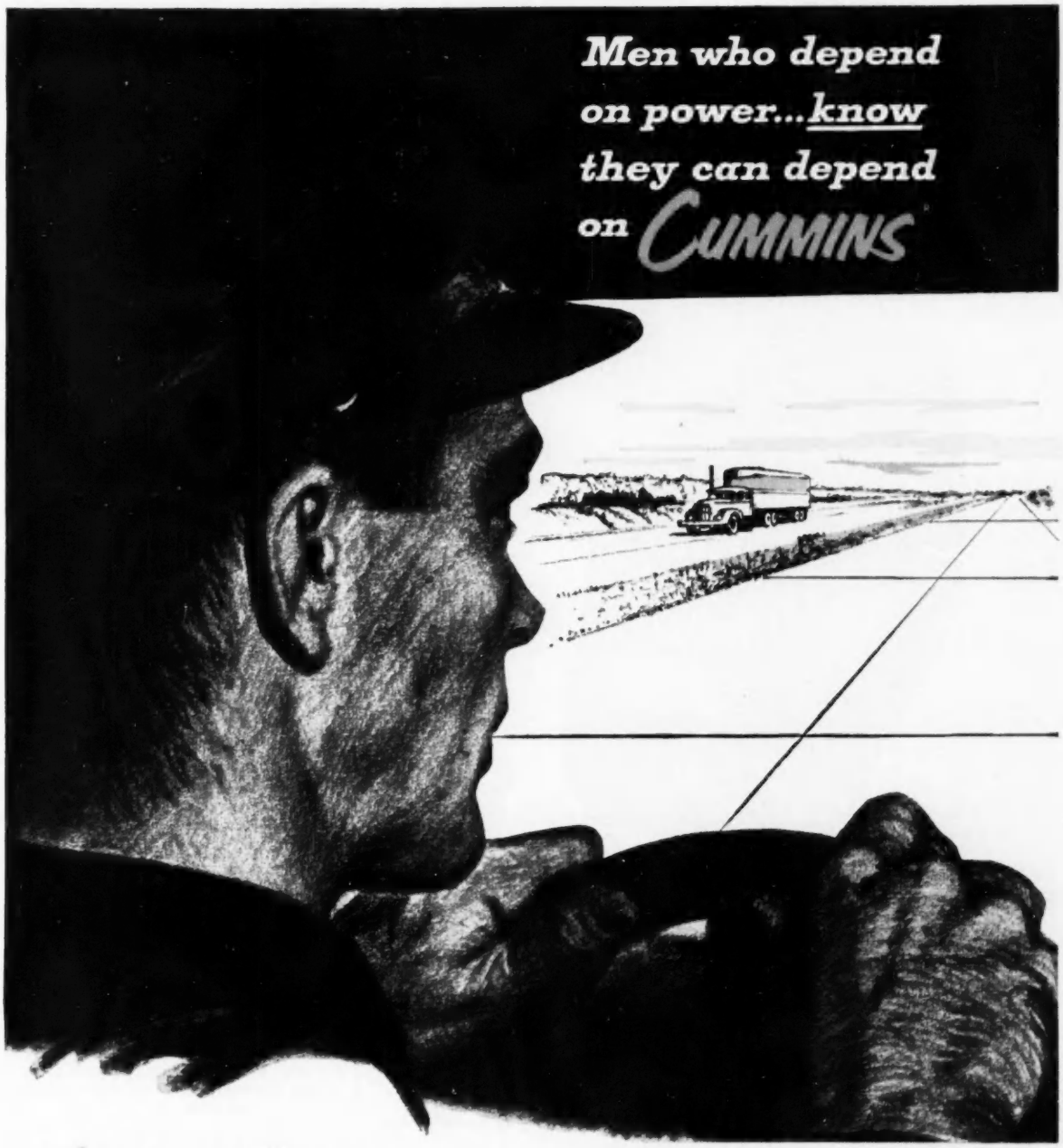
Fire Protection Problem Looms Larger

Based on paper by

W. E. KAVASCH
Douglas Aircraft Co., Inc.

PROVIDING adequate fire protection for the powerplant of a modern highspeed aircraft has become increasingly difficult. We have been goading the engine manufacturer into building a bigger, hotter, fire in his product, especially when an afterburner is involved, thereby increasing fuselage compartment temperatures. The design job boils down to installing this inferno with its many potential ignition sources into a tight-fitting fuselage, dangerously close to inflammable liquids.

It is the work done in the initial stages of design which will determine the final degree of protection. Too often, basic fire safety is neglected



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WATERMAN PRODUCTS

Technical Digests

Continued

until late in the program, and then tackled with brute strength and awkwardness. This results in a series of compromises, seemingly adequate on paper, but actually creating a combination of hazards which no amount of struggling with details of design can remedy.

Adequate protection consists of more than a design with appropriate notes on the drawing. After the parts have been fabricated and installed, the designer must inspect to insure that drawing terms such as "liquid tight" and "sealed compartment" are realities. This inspection must be repeated in field service where otherwise the designer's best intentions can be wiped out by careless or improper maintenance. (Paper, "Power Plant Fire Protection," was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Items to Consider Before LPG Conversion

Based on paper by

J. E. GLIDEWELL

Hall Scott Motor Division
ACF-Brill Motors Co.

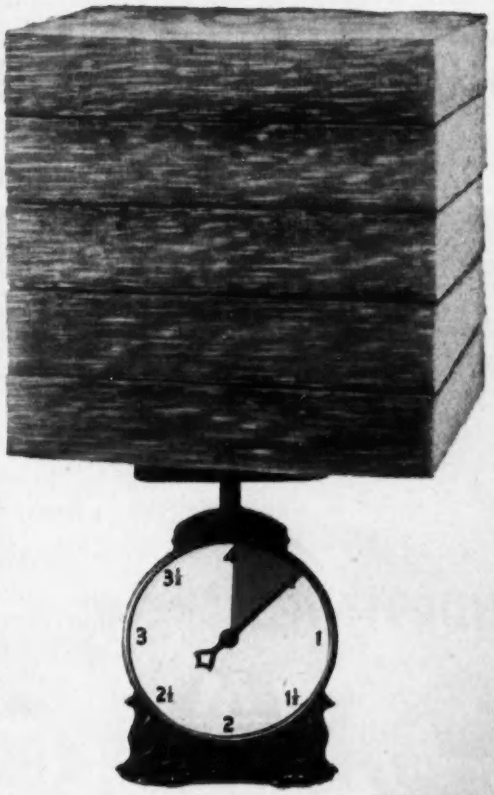
This paper will be printed in full in 1953 SAE Transactions

THERE are a good many matters to look into before switching to LPG engine fueling. If conversion of the engine to a higher compression ratio is involved, the engine manufacturer should be consulted. He may have the necessary parts. If he hasn't the parts, he can at least tell you how to convert and how far you can safely go. Obviously it would be best to buy an engine already set up for LPG.

The next step is to make a study of the availability of the fuel in your territory and its cost relative to the fuel you are now using. Project the amount you will need per month or year, then check with the nearest large supplier to determine the cost in tank car lots delivered. Also, figure the possible economies in having your own storage facilities.

LPG will give increased engine power provided the compresion ratio is raised to take advantage of the fuel octane number. Using LPG should decrease maintenance costs; experience has proven this. You can also

One weigh to know

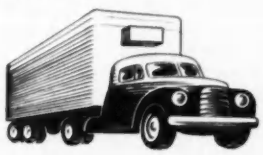


MICROLITE . . .
insulates efficiently against heat transfer

MICROLITE . . .
is an excellent sound absorber

MICROLITE . . .
resists settling under vibration

MICROLITE . . .
is featherlight—available in one-half to one pound densities



MICROLITE . . .
is made from inorganic glass fibers

MICROLITE . . .
has a high degree of tensile strength

MICROLITE . . .
is soft and pleasant to handle

MICROLITE . . .
compresses readily and springs back to its original thickness

MICROLITE ***Glass Fiber Insulating Wool*** **becomes important to you the moment you know a cubic foot can weigh but half a pound. When you also know this feather-lightness is combined with remarkable tensile strength, extreme resilience and pleasant-to-the-touch softness, you realize how easily one man can manage a large blanket of Microlite. It cuts readily into any shape, folds and bends at will, squeezes into tight spots and quickly springs back to its original thickness, filling irregular spaces without leaving voids.**

Inch for inch, Microlite is one of the most effective of all insulating materials. You can't conscientiously proceed with any insulating job—in *passenger cars . . . refrigerated trucks . . . busses . . .* or *aircraft*—until you've investigated Microlite, a product of Glass Fibers' exclusive electronic-extrusion process. Write for all the facts. *Glass Fibers Inc., 1810 Madison Avenue, Toledo 2, Ohio.*

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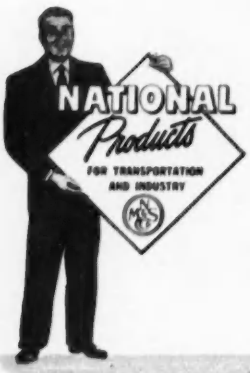
Makers of glass fibers by the ELECTRONIC-EXTRUSION process . . . developed, patented and used exclusively by Glass Fibers Inc.

VITRON Yarns • Rovings • Micro-Fibers • Pipe Wraps • Industrial Mats • MICROLITE Thermal and Acoustical Insulation • DURAMAT Vapor Barriers • VIBRAGLASS Mounting and Packaging Materials • COUSTIC-AIRE and THERMO JET Aircraft Insulations

Castings by National

selected for Quality and Dependability



Products bearing these familiar trademarks have all established enviable reputations for quality and dependability.
These manufacturers *continue* to procure castings by National—one of the Nation's largest founders.

National's unparalleled experience in producing malleable, heat-treated malleable, and steel castings is at your disposal. Sales offices and engineering facilities are located at all five strategically located plants. A-5046

PLANTS LOCATED IN Sharon, Pa., Cleveland 6, Ohio, Indianapolis 6, Ind., Melrose Park, Ill., and Chicago 50, Ill.

A 16mm technicolor film. Narrated by Edwin C. Hill, this 27-minute film tells how malleable iron is made . . . tested . . . used . . . how its production economy, ductility, machinability, toughness will give you a better finished product. Available for group showings.

NATIONAL Products FOR TRANSPORTATION AND INDUSTRY

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY
CLEVELAND 6, OHIO Est. 1868

Technical Digests

Continued

extend the mileage between oil changes with LPG. (Plan to use a lighter grade when you convert. There is no dilution with LPG; therefore, the oil in the crankcase tends to become heavier with use.) Depending upon the load factor, spark plugs one grade "colder" will probably give the best performance. (Paper, "Engines to Digest the Vitamin Enriched Fuel—ElPeeGee," was presented at SAE National West Coast Meeting, San Francisco, Aug. 12, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Diesters in Lubes Gain in Military Use

Based on paper by

V. W. WARE
Rohm & Haas Co.

SINCE the introduction of diesters in aircraft instrument oil and aircraft grease during World War II, other lubrication uses have been considered. They show great promise for power transfer fluids, small arms and machine gun lubrication, and for lubrication, and power transfer media in recent designs of aviation gas turbine engines.

To justify their higher cost, these diesters must possess unusual properties. What makes them particularly interesting to the military is their extremely low volatility combined with low viscosity at very low temperatures, properties which are the principal deficiencies of mineral oils. These qualities imply low pour points and high viscosity indexes.

Diesters also have a stability and an ability to lubricate equivalent to that of mineral oil. They are stable to heat and oxidation, and are difficult to hydrolyze. They dissolve and respond readily to the action of the ordinary antioxidants, detergents, bearing corrosion inhibitors, rust preventives and extreme-pressure agents. (Paper, "Diesters and the Properties Which Make Them Useful as Specialty Lubricants," was presented at SAE National Fuels and Lubricants Meeting, Tulsa, Nov. 7, 1952. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers).

Why worry NOW about product costs?

Company sales are good!
And everybody's prices are high!

HOLD ON A MINUTE, THOUGH!

Detroit's cut price tags on '53 cars—and put a sales push behind them. Looks as if competition is here again. So why don't **you** keep a step ahead of **your** front office?

Be the **first** in your company to plug new product thinking—cost-wise and performance-wise.

Here's an idea: specify

"COMPO"® and "POWDIRON"® bearings and parts

(porous bronze) (sintered iron)

These oil-retaining products of Bound Brook powder metallurgy . . .

last for years without attention. Often **outlast** the product in which they are installed.

Cut down on size of metal housings.

Need no skilled labor to install.

Like to know what to *tell* front office about these bearings and parts? Our bulletins on advantages, applications, installation methods will give you all the ammunition you need. Just write for copies.

Buy Bound Brook

"COMPO" • "POWDIRON" • "BOUND BROOK"

BOUND BROOK
OIL-LESS BEARING COMPANY

Bound Brook, N. J. **Bound Brook 9-0441**
MANUFACTURERS OF BEARINGS AND PARTS • ESTABLISHED 1883

Piasecki uses

KLIXON

CIRCUIT BREAKERS

for the Famous Hup-2 Helicopter

In designing the HUP-2 helicopter, Piasecki engineers recognized the importance of accurate and reliable circuit protection. That's why you'll find Klixon Circuit Breakers on both circuit breaker panels as well as in the engine junction box.

Compact, light-weight, Klixon Breakers withstand shock, vibration, motion . . . regardless of the position of mounting. They perform accurately and efficiently guarding circuits against overloads in all ranges of altitude and under all flying conditions.

Regardless of the type of aircraft, trainer, fighter, bomber, transport, you'll find Klixon breakers . . . switch and push-button, indicating and non-indicating, remotes and automatics, and others . . . protecting electrical circuits.

Send for complete bulletins showing sizes, dimensions and performance characteristics of Klixon Breakers.

KLIXON

SPENCER THERMOSTAT

Division of Metals & Controls Corp.

1506 FOREST ST., ATTLEBORO, MASS.

New Members Qualified

These applicants qualified for admission to the Society between Feb. 10, 1953 and March 10, 1953. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Atlanta Group

Kenneth M. Brooks (J).

Baltimore Section

George Andrew Bamford (M), Edwin R. Larson (SM), Paul W. Wheeler (J).

British Columbia Section

John Holdsworth (J), James McGown, Jr. (J), John Edmund Umiker (J).

Canadian Section

E. D. McQuigge (A).

Central Illinois Section

Frederick William Beyer, Jr. (M), Harold C. Davidson (J), Franklin O. Koch, Jr. (J), Frank A. Kottmeier (A), Roger H. Williams (J), Maurice E. Young (J).

Chicago Section

Charles Blair Banks (M), T. M. Ephgrave (M), Werner A. Gans (J), Marcus Walter Hagen (J), Donald J. Huegerich (J), Wallace S. Johnson (J), Walter Kocolowski (M), Julius E. Mikulak (J), James J. Powlas (A), J. H. Spence (J).

Cincinnati Section

Robert Nelsen (M).

Cleveland Section

Robert Banks (J), Lester Burdorff (J), W. H. Glidden (J), Vincent T. Marusa (J), John Newell, III (J), Eugene Rogowski (J), William A. Weinkamer (M).

Colorado Group

Gardner W. Turman (M).

Dayton Section

Warren G. Craig (J), Anton F. Erickson (M), John William Fulton (J), Paul J. Long, Jr. (M), Sanford Lustig (J).

Detroit Section

John G. Bennister (A), Robert Kron Beasley (J), Francis L. Bedard (J), John Benjamin Clark, Jr. (J), Nick Charles Colovos (J), Joseph Silverman Dykes (J), Douglas H. Foley (J), E. M. Gage (M), George M. Galster (M), Robert T. Gill (A), Henry Richard Greenley (M), R. Fenton Hamilton (M), R. S. Harper (A), Carl M. Heath (A), Edward Clinton Jackson (M), Rudolph J. Jonczy (J), Michael J. Kol-

New Members Qualified

Continued

lins (M), Robert C. Lang (J), DuWayne A. Lochmiller (M), Bobby Jack Ludwig (J), Edwin N. Mattausch (J), Webster Campbell McDonald, Jr. (J), James F. McGowan (J), Allen Harry Minkley, Jr. (A), Lorne Frederick Nedvidek (A), George Nelson, Jr. (A), James R. Phelan (J), John W. Podesta, Jr. (J), Bruce R. Polkinghorne (J), Walter H. Powers (M), Edward W. Pugh (A), Robert L. Shick (J), Charles Stevens Snyder (J), Norman A. Stenzel (J), Donnell Robert Sullivan (J), Harold Thom, Jr. (J), Isaac Stephen Van Wart (M), Clarence H. Wheeler (J), Joseph Ford White (M), Frank E. Young, Jr. (J).

Hawaii Section

Everett Winfrey Keen (A), Henry Oscar Lai Hipp (A).

Indiana Section

William L. Adkins (J), Walter J. Behrens (M), Robert Martin Crow (J), Paul Robert Lepisto (J).

Kansas City Section

J. E. Creason (M), Kenneth Allen Orear (J).

Metropolitan Section

Parker M. Bartlett (M), Vernon A. Clanton (A), Charles Frendock (J), Franklyn H. Green (M), Norman H. Hashkowitz (J), George A. Metz (J), Philip L. Muller, Jr. (J), Charles A. Roller (J), David L. Staiger (M), Anthony Testa (M).

Mid-Michigan Section

Robert W. Chase (M), Robert M. Gold (J), Eugene Gottschalk (M), John Allen McDougal (M), George L. Punches (M).

Milwaukee Section

Harold W. Buenger (J), Walter A. Laev, Sr. (A), George W. Taivalkoski (J).

Montreal Section

James A. Bailey (M), Douglas F. Rhodes (M).

New England Section

Harry Paul Boyden (A), Francis G. Haggerty (A).

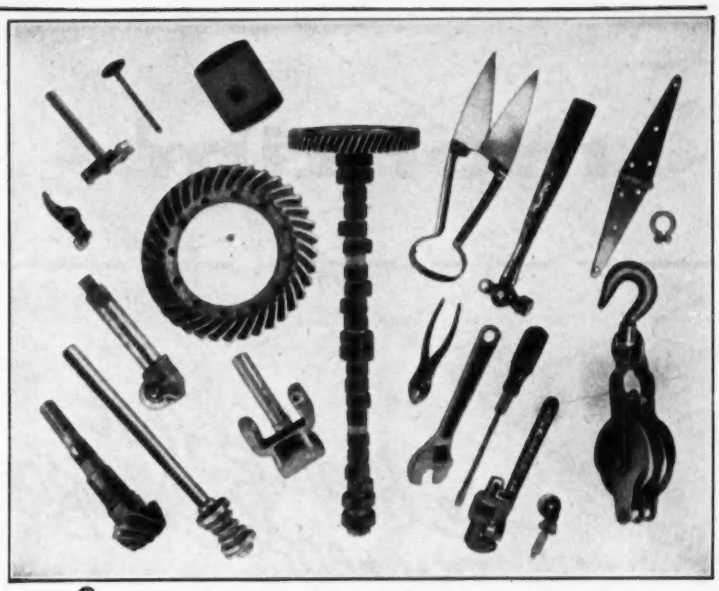
Northern California Section

Donald Earl Carrington (M), Sidney E. Cochran (M), Henry C. Hodges (M), George Richard Picolet (J), Vernon L. Rogallo (M), John C. Wagner (M).

Continued on Page 145

AMERICAN CHEMICAL PAINT COMPANY
AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: RUST PROOFING WITH PERMADINE®



Steel parts that have been Permadized and then "sealed" with a rust-preventive oil such as "Granoleum" are effectively protected from rust. And, if the oiled "Permadine" coating should be damaged, rusting will not spread beyond the area of exposure.

Note: Automotive and other rubbing parts subject to friction are usually given "Thermoil-Granodine" manganese-iron phosphate coatings for both wear-resistance and protection from corrosion.

DATA ON THE "PERMADINE" COATING	
Type of coating	Zinc phosphate
Object of coating	Rust and corrosion prevention
Typical products treated	Nuts, bolts, screws, hardware items, tools, guns, cartridge clips, fire control instruments, metallic belt links, steel aircraft parts, certain steel projectiles and many other components
Government Specifications	U.S.A. 57-0-2C; Type II, Class B MIL-C-16232, Type II U.S.A. 51-70-1, Finish 22.02, Class B AN-F-20 Navy Aeronautical M-364 JAN-L-548
Scale of production	Large or small volume; large or small work
Method of application	Dip Barrel tumbling, racked or basketed work
Equipment notes	Immersion tanks of suitable capacity. Cleaning and rinsing stages can be of mild steel. Coating stage can be of heavy mild steel or stainless steel.
Chemicals required	"Permadine" No. 1
Pre-cleaning methods	Any common degreasing method can be used. Alkali cleaning ("Ridosol"), Acid cleaning ("Deoxidine"), Emulsion-alkali cleaning ("Ridosol" - "Ridoline"); vapor degreasing, solvent wiping, etc., are examples. Acid cleaning may need to follow other cleaning methods if rust or scale is present.
Bath Temperature	190° - 205°F.
Coating time	20 - 40 minutes
Coating weight range	1000 - 4000 mgs. per sq. ft.
Technical Service Data Sheets	No. 7-20-1-2 T.M. No. 5

CHEMICALS ACP PROCESSES WRITE FOR FURTHER INFORMATION ON "PERMADINE" AND YOUR OWN METAL PROTECTION PROBLEMS CHEMICALS ACP PROCESSES

moraine-400

...the bearing that helps new engine designs come true

Because they remove bearing *length* as a limiting factor in engine design, Moraine-400 bearings help to make more compact engines of higher horsepower possible.

For example . . . one of our customers is now developing an engine that will have impressively greater output without greater bulk. Its features include a stiffer crankshaft, larger pistons, more rigid connecting rods . . . and, because Moraine-400s are being used . . . *narrower bearings!* In addition, tests indicate that bearing life will be increased as much as *400 per cent!*

May we suggest that your engineers consider Moraine-400 bearings in designing and developing your engines of the future.

moraine products

DIVISION OF GENERAL MOTORS CORPORATION • DAYTON, OHIO

New Members Qualified

Continued

Northwest Section

Hal S. Huskinson (J), Kendall W. Macdonald (J), Jerry A. Roquet (J).

Philadelphia Section

John Joseph Geoghegan (J), Edward Francis Gowen (M), Ensign Philip B. Taylor, Jr. (J), Daniel Bernard Weinstein (J).

Pittsburgh Section

Alvin B. Esterberg (A), George C. Schrade (M).

St. Louis Section

Walter Wayne Barber (J).

San Diego Section

William O. Edell (M), Henry Poniktera (M), Ernest G. Stout (M).

Southern California Section

Robert Clarence Allen (J), Ngaiman Au (J), Lt. Col. Harry N. Bailey (SM), Joseph Rudolph Faitel (J), Richard I. Himmelberger (M), Earl G. Peters (M), Cecil W. Roenfeldt (M), Andrew L. Savulak (M), Rodney E. Schapel (A), Jerome LeRoy White (J), Robert Edward Wieneke (M).

Syracuse Section

John Taylor Davidson (A).

Texas Section

L. W. Conine (M), Lloyd M. Cregor, Jr. (A), Elliott L. Hovel (A), Jack Raymond Meadows (A), Roy Redmond (M), Learon R. Shankle (M), Robert Dean Slonneger (M), James Sherwin Warnick (J).

Twin City Section

Edward R. Sewall (J), Stanley J. Willis (J).

Washington Section

Melvin Neilson Gough (SM), George W. Haldeman (SM), Frank Sales Pohanka, Jr. (J).

Western Michigan Section

Earle J. Seward (M).

Williamsport Group

Paul G. Mays (A).

Outside Section Territory

Leslie L. Cahan (J), Ray E. Carter (M), Eduardo Velazquez Chavez (M),

Continued on Page 147

...out of this came Aviation

... an industry that created the need for suppliers with the manufacturing facilities and craftsmen to produce consistent quality precision parts and assemblies. The Indiana Gear Works has been serving the aviation industry since 1933—accumulating twenty years of precision experience that enables I.G.W. to match design intelligence with creative production.

Behind these doors is a modern plant with the finest precision production facilities and skilled craftsmen guided by modern methods and procedures. This is a plant where quality is more than a word —it's a method of manufacturing.

INDIANA GEAR

INDIANA GEAR WORKS, INC. • INDIANAPOLIS 7, INDIANA

. . . for smoother Performance and Peak Dependability

Velvetouch *all-metal* Friction Discs

ARE STANDARD EQUIPMENT ON

FORDOMATIC AND MERCOMATIC TRANSMISSIONS

Ford engineers and technicians, in developing the now-famous Fordomatic and Mercomatic transmissions, chose Velvetouch for both units.

All-metal Velvetouch has a long life... it insures a smoother, more dependable transfer of power and it won't deteriorate in oil like ordinary friction material.

These field-proven Velvetouch advantages are recognized by experienced design engineers in all industry. For whether it's the clutch in a delicate computing machine, or the automatic-transmission on a multi-ton tractor or tank... they know that all-metal Velvetouch is our answer to established operating excellence.

Our technicians will be glad to work with you in solving your clutch and brake problems. Just call our nearest office, or write The S. K. Wellman Co., 200 Egbert Rd., Bedford, Ohio.

Velvetouch

THE S. K. WELLMAN CO. SALES OFFICES AND WAREHOUSES

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* CHICAGO — 1500 South Western Ave., Chicago 8, Illinois

* CLEVELAND — 200 Egbert Rd., Bedford, Ohio

* DALLAS — 3407 Main Street, Dallas 1, Texas

** DETROIT — 16622 James Couzens Highway, Detroit 21, Mich.

* LOS ANGELES — 1110 South Hope St., Los Angeles 15, Cal.

* PHILADELPHIA — 1545 West Belfield Ave., Philadelphia 41, Pa.

* PORTLAND — 636 N. W. 18th Ave., Portland 9, Oregon

* SAN FRANCISCO — 424 Bryant Street, San Francisco 7, Calif.

* TORONTO, ONTARIO — The S. K. Wellman Co. of Canada, Ltd., 2839 Dufferin St.

** WASHINGTON — 1101 Vermont Ave., N. W., Washington 5, D. C.

** EXPORT DEPARTMENT — 8 South Michigan Ave., Chicago 3, Illinois

* SALES OFFICE AND WAREHOUSE ** SALES OFFICE

New Members Qualified

Continued

Russell L. Dahl (J), Christian Hess (M), Edmund G. Janssen, Jr. (J), William H. Leinbach (A), Lawrence E. Palatnik (J), Gordon C. Rucks (J), David Schafale (M), Norman S. Smith (M), Jack J. Stilson (A), Clarence Lester Walker (J), Robert Glenn Woodward (M).

Foreign

F. Karl Goerner (FM), Germany; Robert D. High (J), India; Abdul Fattah K. Kaddou (J), Iraq; Avinash Kapur (FM), India; Richard Francis McGill (J), Belgium; Thomas Hiraaki Yamamoto (FM), Japan.

Applications Received

The applications for membership received between Feb. 10, 1953 and March 10, 1953 are listed below.

Baltimore Section

Benjamin Goldfarb.

British Columbia Section

Rodney Haslam Baird, James Arthur Rice.

Canadian Section

Norman Hamilton Dalziel, Peter J. Lyons, William August Vahs.

Central Illinois Section

Donald C. Barrick, William E. Deluhery, R. C. Hinrichs, Thomas C. Kingsley, William James Robb, Victor A. Woodling.

Chicago Section

Dubose Avery, Joseph F. Bower, Leo M. Brieske, Jr., Earl W. Bryan, Richard M. Fegan, D. Wendell Fentress, Henry Knippenberg, III, W. L. Naumann, Raymond Peter Niesman, Richard V. Nutt, Wynn E. Petersen, Willis H. Risse, John D. Rose, Jr., Louis E. Ruffolo, George Edgar Stanton, Jr., TeFung Yeh.

Cincinnati Section

Sherman E. Crites.

Cleveland Section

William A. Betz, Ralph H. Erlanger, Richard J. Henderson, Ambrose John Ilg, Virgil P. Jenney, Richard Stanley Kopchynski, Wilton Margrave, Wallace H. Nichols, Robert E. Sheahan, Dallas L. Sprinkle, John E. Stott, Robert H. Sweeney, William G. Webster, C. Joseph Yuncker.

Continued on Page 148

American Helicopter Co. XH-26 "Jet-Jeep"

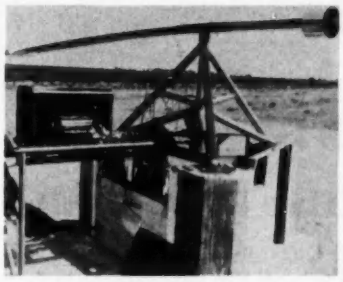
EMERY SOLVED THIS WEIGHING PROBLEM

FOR THE AMERICAN HELICOPTER CO., Mesa, Ariz.

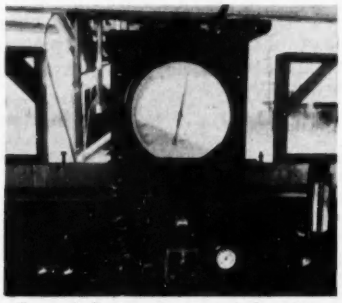
THE PROBLEM: Determine the thrust of rotor tip-mounted pulse-jet engines under simulated flight conditions.

THE SETUP: A single, counterweighted, main rotor blade with pulse-jet unit is mounted on a test stand. A Chrysler industrial engine, geared to rotate the blade under test, is mounted on a cradle suspended from two points on the centerline of its own drive shaft.

THE SOLUTION: Emery Closed Hydraulic Weighing System. An EC-30 Cell "weighs" the reactive torque developed between the Chrysler motor cradle and its support frame at any desired rotor speed. The industrial engine is then uncoupled from the rotor shaft, and the rotor turned by the pulse-jet unit at the same speed. The torque provided by the pulse-jet engine is the same (after correction for mechanical power transmission and other losses) as that required of the Chrysler engine to run the rotor at the given rate.



Pulse-Jet Rotor mounted on Test Stand



Emery Indicator at test control station

A 16 INCH, 0-1000 POUND Emery Bourdon Indicator is mounted with other instruments and controls at the operator's station beneath the test stand. The Emery indicator is calibrated in two-pound increments.

ACCURACY WAS PROVEN by American Helicopter Co. engineers, who found the Emery system provided thrust data whose error was less than 1%.

LET EMERY SOLVE YOUR WEIGHING PROBLEM

AT LOW COST for purchase and operation.

WIDE RANGE of stock sizes of Emery Closed Hydraulic, Hydraulic Flow, and Pneumatic Cells permit precision measurement of 1 to 100,000 pounds. Also special sizes up to 10,000,000 pounds.

WRITE TODAY FOR ALL THE FACTS on how Emery can solve YOUR Force Measuring Problem in Precision Weighing . . . Brake Testing . . . Torque or Torsion Measurements . . . Cable, Chain or Rope Testing . . . Strength of Materials or Structures . . . Jet Engine Thrust . . . Towing or Traction Tests . . . or some unusual application of your own. Emery Engineers welcome your most difficult weighing problem.

THE A. H. EMERY CO. **NEW CANAAN 4, CONNECTICUT**

Please send literature on Hydraulic Weighing ( ) Pneumatic Weighing ( ) TEL. NEW CANAAN 9-9595

Our problem is:_____

_____

_____

Max. load_____ % Accuracy required_____

Max. permitted response time lag_____

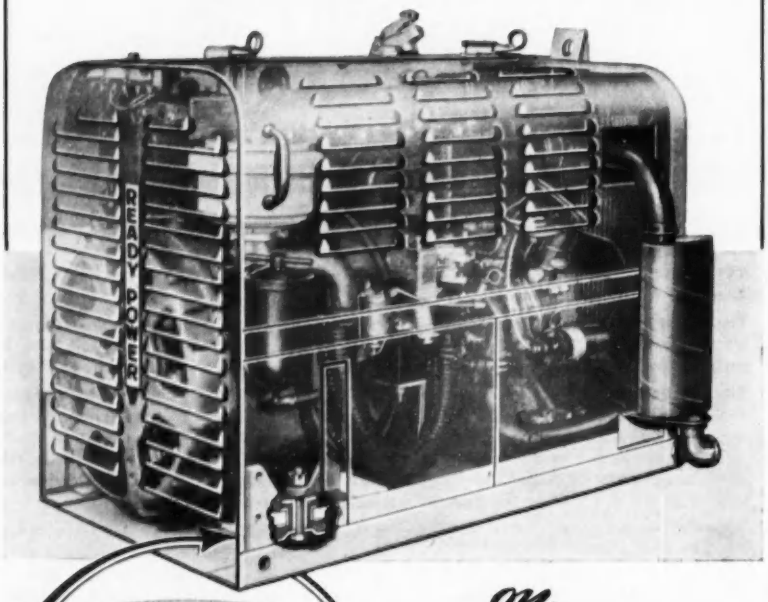
NAME_____

POSITION_____

(Please attach to your business letterhead)

THE A. H. EMERY CO. PRECISION SINCE 1872 FORCE MEASUREMENT

LORD MOUNTINGS
SERVE DUAL PURPOSE

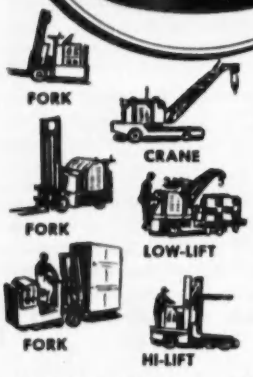


on

THE READY-POWER CO.

"Live Power Units"

LORD Shock Mountings accomplish two vital objectives in the delivery of "Live Power" generated as needed directly on the truck chassis of industrial fork trucks, tractors, cranes and locomotives by Ready Power Units.



1. The upper Lord Mounting J-4497-2 absorbs the unusually high "g" shock loads encountered in industrial lift truck service . . . At the same time it is rigid enough to prevent excessive engine motion due to these destructive shock loads.

2. The lower member J-4591-1 is a rebound snubbing washer thicker than the sandwich section of the upper member J-4497-2. Precompression thus allows variable bracket thickness of plus or minus 1/16 inch. Thus the Lord Mountings serve the dual purpose of minimizing the vibration and the multiple shocks to which Ready-Power units are subjected in powering the heavy tools of industry. You can profit by Lord experience in the control of vibration and shock. Write or call . . .

BURBANK, CALIFORNIA — 233 South Third Street
DALLAS, TEXAS — 413 Fidelity Union Life Building
PHILADELPHIA 7, PENNSYLVANIA — 725 Widener Building
DAYTON 2, OHIO — 410 West First Street
DETROIT 2, MICHIGAN — 7310 Woodward Ave.
NEW YORK 16, NEW YORK — 280 Madison Avenue
CHICAGO 11, ILLINOIS — 520 N. Michigan Ave.
CLEVELAND 15, O. — Room 811, Hanna Bldg.

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for
VIBRATION CONTROL

Applications Received

Continued

Detroit Section

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Jack S. Crusoe, Richard Lawrence.

Continued on Page 150

A Durable Platform of Comfortable Support

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Spokane-Intermountain Section
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Vern A. Bapst, John W. Brown, Parnell Haney, Layton R. Milton, George Reindel, Jr., Nyall Gibson Tweedle, J. P. Wagner, Philip F. Walters, Bernard William Wortelboer, Joseph E. Kirk.

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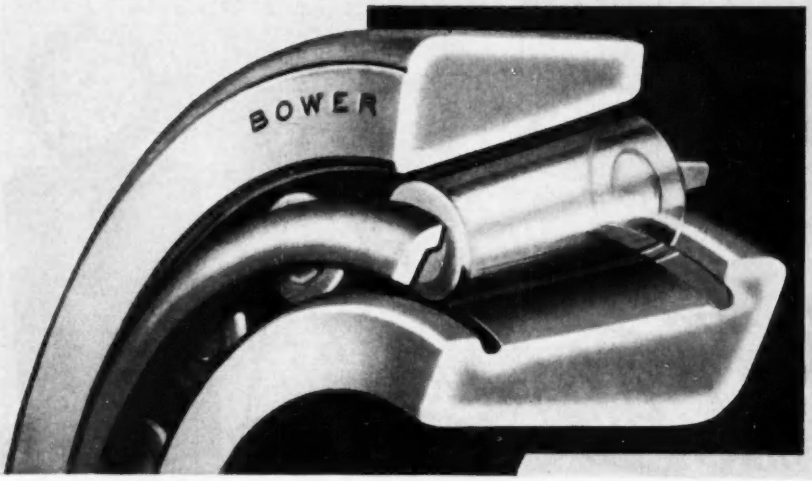
Bower spher-o-honed design provides better bearing lubrication



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The large oil groove built into Bower Spher-O-Honed bearings is just *one* of several important Bower design features which reduce maintenance and increase efficiency. Combine it with generated spherical roll-heads and a higher flange surface, and smooth, precision-honed races, and you have the basic elements of Spher-O-Honed design.

A careful look at the illustration above will show you other important Bower features, too. Note particularly that the roller heads contact the flange over a wide two-zone area—thus reducing wear and minimizing resultant "end play."

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ROLLER BEARINGS

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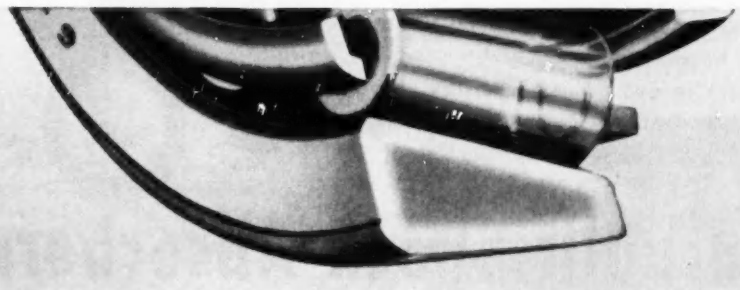

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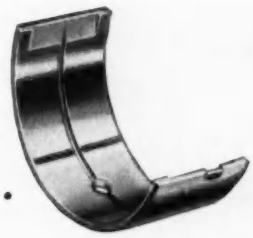
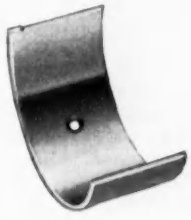
There are Delco designs for every automotive application —cars, trucks, buses, military vehicles—and Delco production facilities insure prompt delivery. For detailed information get in touch with Delco Products, Division of General Motors Corporation, Dayton, Ohio.

Delco Hydraulic Shock Absorbers

Sleeve bearings . . .  more than 50 years specialized experience. Research, design, quality control, quantity production. Widest range of sizes and lining alloys  on bronze or steel backs. Complete engineering service. Long or short runs for automotive and industrial requirements.

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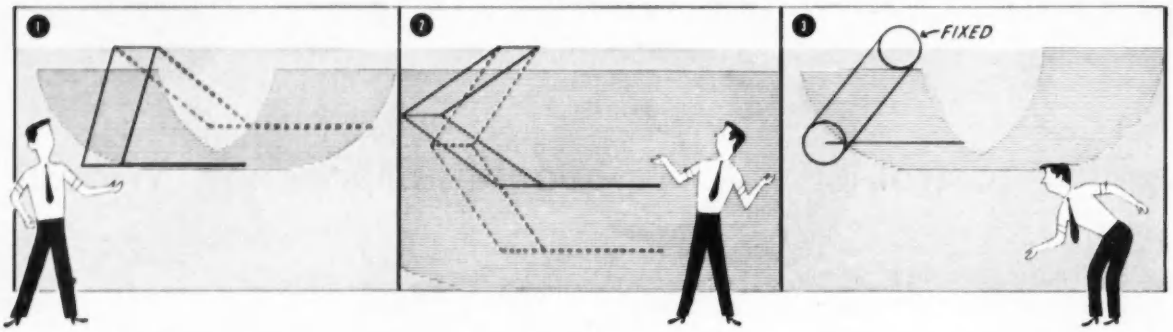


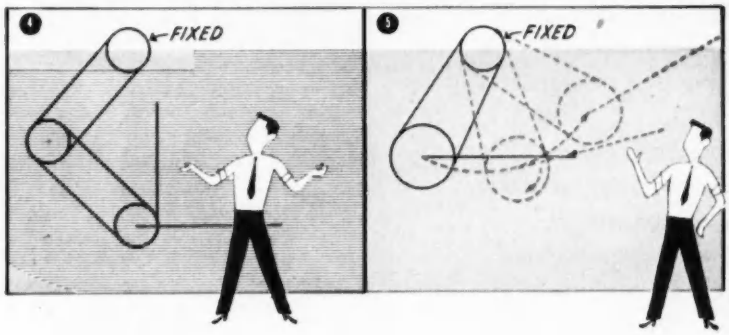
Start with a parallelogram somewhat like this. Visualize one of its short sides anchored to the top of a drawing board parallel to your base line, and let the remaining three sides be free to move together. Add a projecting straightedge to the bottom side as shown, and it will theoretically stay parallel to the base line. Parallel lines could be drawn anywhere within the shaded area above. But clearly, that field of action is too limited.

To obtain parallel motion over the entire working surface of the board, a second parallelogram could be coupled to the bottom of the first so that both have one short side in common. An elementary drafting machine would result . . . at least in principle. In practice, it would fall short because the slightest play at any of its 8 joints would create gross error at the straightedge.

What is needed is a better mechanical design based on the same parallelogram principle. Take a pair of rotating drums, connect them with a tight steel band, and the assembly will behave like a parallelogram if the drum diameters are equal. Now couple a second band-and-drum assembly to the first in such a way that they have the middle drum in common . . . and you have the basis of a modern drafting machine.

and find out WHY— BETTER!"

The Right Angle



The band-and-drum machine, with all three drums of precisely equal diameters and with bands which will not slip, will draw absolutely parallel lines over the entire working area. But if the drum diameters are not equal, the parallelogram principle is violated and the machine cannot draw parallel lines. The greater the difference in diameter the more the lines will be out of parallel.

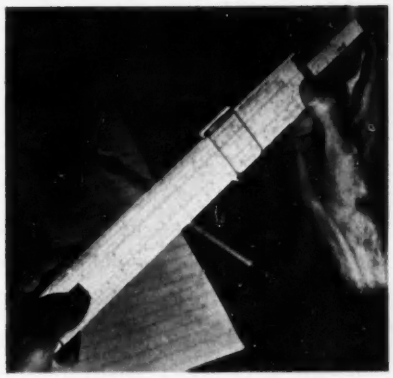
Here, in exaggerated form, is what happens when two of the drums are not equal in diameter. This could occur in either arm of the machine, conceivably in both arms with the errors being additive. From this it is clear that a central factor in the accuracy of a drafting machine is the accuracy of all drum diameters. That is why K&E goes to very extraordinary lengths in this regard in building PARAGON Drafting Machines.

These basic principles and the advanced engineering design in the PARAGON combine to give you the finest in drafting machines. You realize this as soon as you place your hand on the controls.

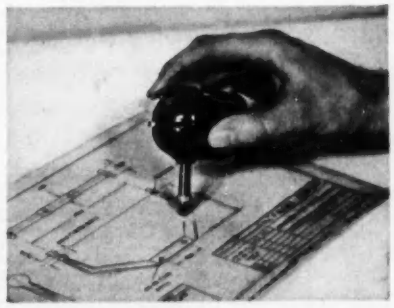
The scales rotate freely with the lightest pressure on the protractor control ring. Release it and they are locked at the nearest 15° position. Intermediate angles are easily set.

Another PARAGON feature is the open center construction of the arms. Even when they are twisted by lifting the head of the instrument off the board, it is impossible to disturb the factory-set band tension.

Ask your K&E Distributor or Branch to tell you about other PARAGON features or give you an actual demonstration.



An engineer without a K&E Slide Rule is like a doctor without a stethoscope. It's the badge of the profession . . . with good reason. The first American-made slide rule was a K&E, and generations have known these rules for their precision, readability and velvet-smooth operation. They come in all types.



After you've once used a K&E MOTORASER,† you'd no more go back to hand erasing than you'd take to drawing with your gloves on. With MOTORASER you can either pin-point your objective, or cover a larger area without damage to the drawing surface. Runs on 110 volt 60 cycle AC, or DC with an inexpensive adapter.

†TRADE MARK

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Is long service life at low cost your problem?

here's how leading tractor manufacturers solve it with NEEDLE BEARINGS

Many makers of farm tractors specify Torrington Needle Bearings because of their relatively low cost and their long maintenance-free operation under rugged conditions.

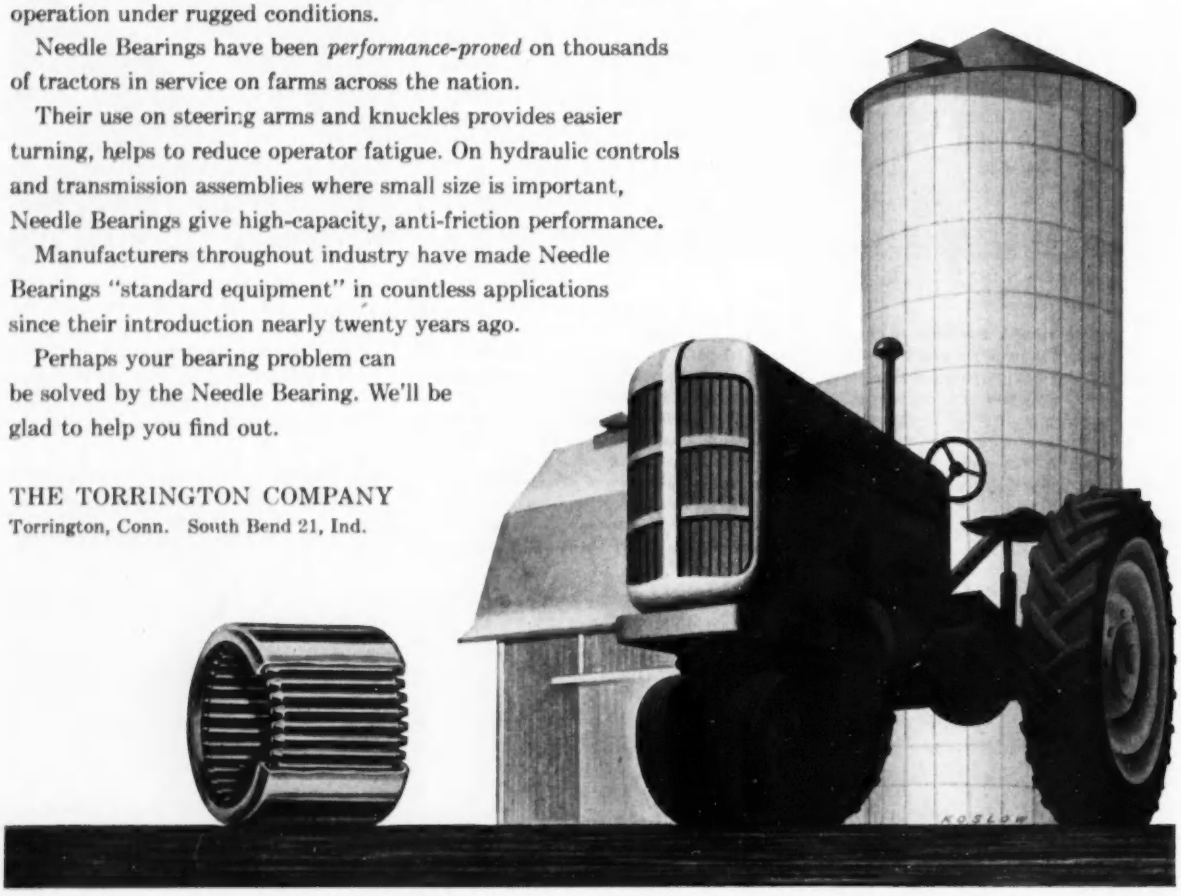
Needle Bearings have been *performance-proved* on thousands of tractors in service on farms across the nation.

Their use on steering arms and knuckles provides easier turning, helps to reduce operator fatigue. On hydraulic controls and transmission assemblies where small size is important, Needle Bearings give high-capacity, anti-friction performance.

Manufacturers throughout industry have made Needle Bearings "standard equipment" in countless applications since their introduction nearly twenty years ago.

Perhaps your bearing problem can be solved by the Needle Bearing. We'll be glad to help you find out.

THE TORRINGTON COMPANY
Torrington, Conn. South Bend 21, Ind.



TORRINGTON NEEDLE BEARINGS

Needle • Spherical Roller • Tapered Roller • Straight Roller • Ball • Needle Rollers

Trade-marks of some of the manufacturers who use Needle Bearings

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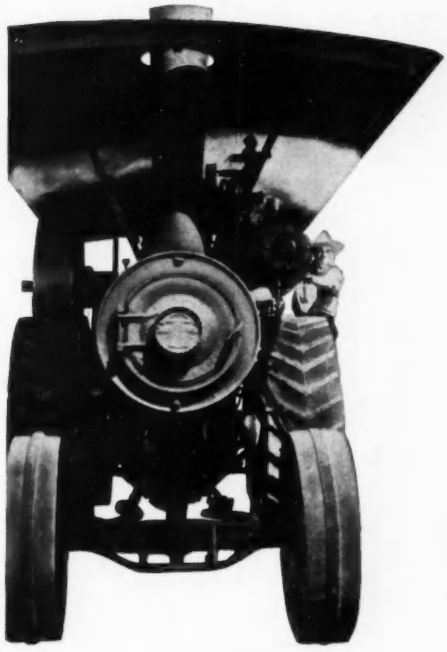
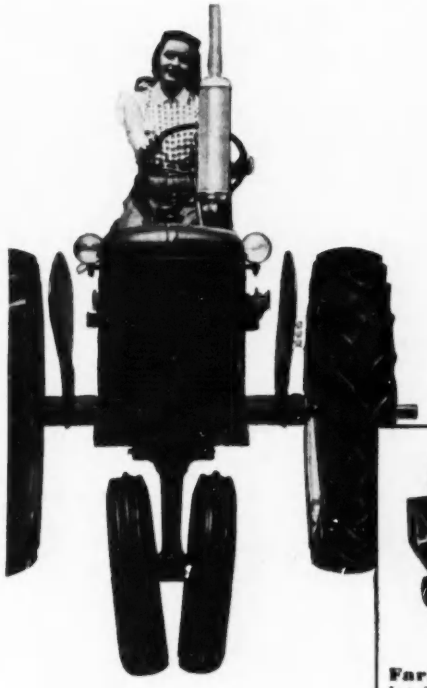


FARMERS expect more from tractors than ever before. They must be economical to operate . . . and above all, dependable. Tractors need water pumps and fuel pumps that will assure uninterrupted performance, especially at planting and harvest times. Hydraulic pumps to actuate tractor implements are of equal importance.

These pumps are among the many things that have been engineered and are being precision built by Thompson for the automotive and aircraft industries.

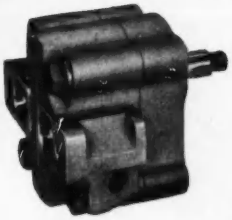
All the techniques and skills gained in making unbelievably complex items, many made to the closest

Pump Performance you can take for granted!



tolerances, are applied to Thompson pumps. This means that every one assures maximum performance and dependability.

If you need pumps to cool your engines, to raise and lower your farm implements or industrial pumps to keep your product cooled, write or phone *Special Products Division, Thompson Products, Inc., 2196 Clarkwood Road, Cleveland 3, Ohio.*



Farm Implement Pump.
Let Thompson's Special Products Division work with you on your hydraulic pump problems.

You can count on Thompson Products

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Drive-in Deep Freezer Tests Aluminum Automotive Products

40° below zero cold room serves designers and project engineers

Arctic temperatures, homemade in Alcoa's laboratories, sped aluminum piston development. Many aluminum pistons were tested by parka-clad Alcoa engineers for cold-scuffing, noise-level, and expansion characteristics. Now, aluminum pistons are standard equipment in all '53 makes.

Alcoa's frigid proving ground helped meet Army deadlines for a new tank crankcase . . . clipped weeks from the development time of new valve lifters . . . found the cold-weather starting secrets of foreign diesel engines.

Like all of Alcoa's research and development facilities, our drive-in deep freezer is available to help you apply aluminum's advantages to your automotive product. To get in touch with the Alcoa engineering specialists in your field, call the nearest Alcoa sales office. Or write directly to us, outlining the project you have in mind.

Alcoa Aluminum

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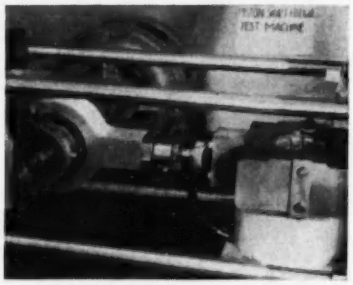
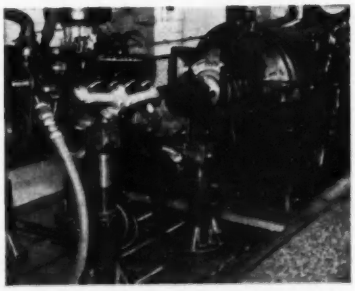


Development work on aluminum pistons continues with fatigue tests on this special machine built by Alcoa.

Engineering specialists conducting torsion tests of a stiffened aluminum alloy cylinder.



One of Alcoa's battery of dynamometers for testing internal combustion engines.

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Please send me a copy of your "Road Map to a Better Product" outlining Alcoa's research and development facilities.

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...means GREATER RELIABILITY on any hauling job!

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THE WORLD'S MOST TRIED AND TRUSTED

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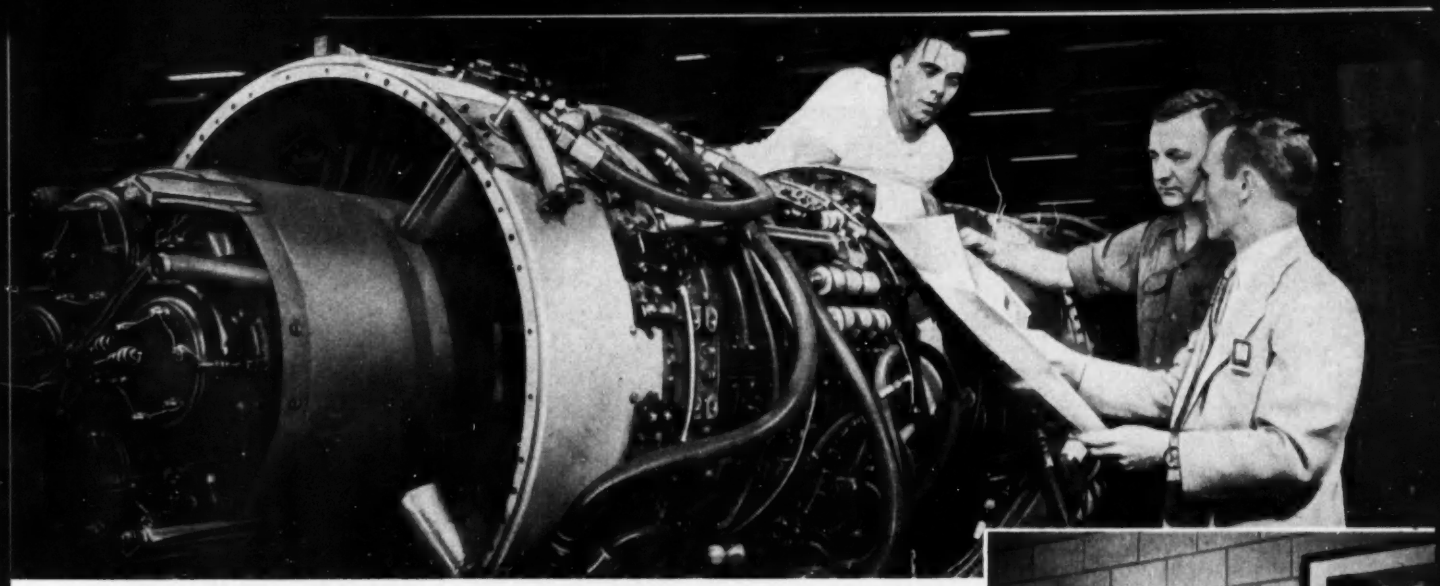

JET EXPERT — Ray Small, right, an Engine Project Manager, keeps close contact with his engineering personnel and with the engines that he is responsible for from development and testing through production and delivery.

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Many of the creative jet engineers now employed at our Jet Center helped G.E. develop this nation's first jet engine 10 years ago.

At General Electric's Aircraft Gas Turbine Division, you, the creative engineer, will have every encouragement, every facility to assist you with engine development problems. Steady advancement and satisfying stability are but a few of the prospects before you with G.E. at Evendale.

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VIBRATION AND DAMPENING	INSTRUMENTATION	SERVO-MECHANISMS

Positions are available at West Lynn, Mass. and Cincinnati, Ohio. Please do not apply if your best skills are being used for vital defense work. Send your resume to: Technical and Supervisory Personnel, Aircraft Gas Turbine Division, Dept. S.

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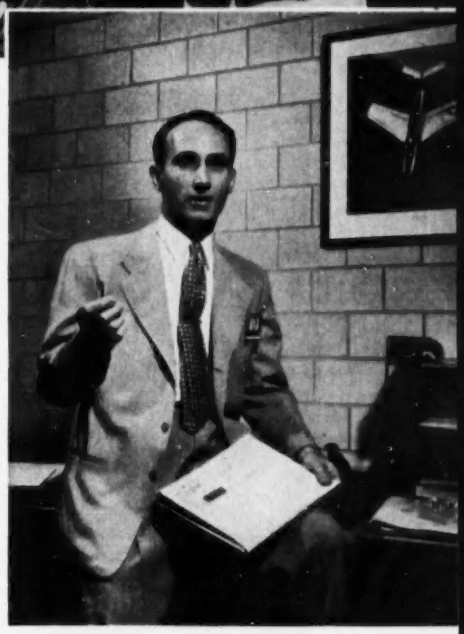
CINCINNATI 15, OHIO



YOUNG VETERAN — Starting as a Test Engineer in the company's training program in 1940, Mr. Small has made a rapid climb in the company's Aircraft Gas Turbine Division, so that today, he holds a responsible position as a Project Manager, guiding the development of Boeing B-47 jet engines.

STRATEGIC BOMBER — Six G-E jets power this Boeing B-47 medium bomber, which recently set a new speed record from Hawaii to the United States.

RYAN

Aircraft and Aeronautical Products

Leaders in High-Temperature Metallurgy

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Metal Products Division • Jet Engine Components • Exhaust Systems • Rocket Assemblies

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Available in ALL Types to Meet the Requirements of ALL Engines

As a pioneer in the hydraulic valve lifter field, and the major producer of hydraulic lifters for 25 years, Eaton is equipped by both experience and production facilities to meet the particular requirements of each engine. Eaton Hydraulic Valve Lifters are available in all types and in all materials, including heat-treated steel, hardenable iron, chilled face, and puddled face types.

EATON MANUFACTURING COMPANY

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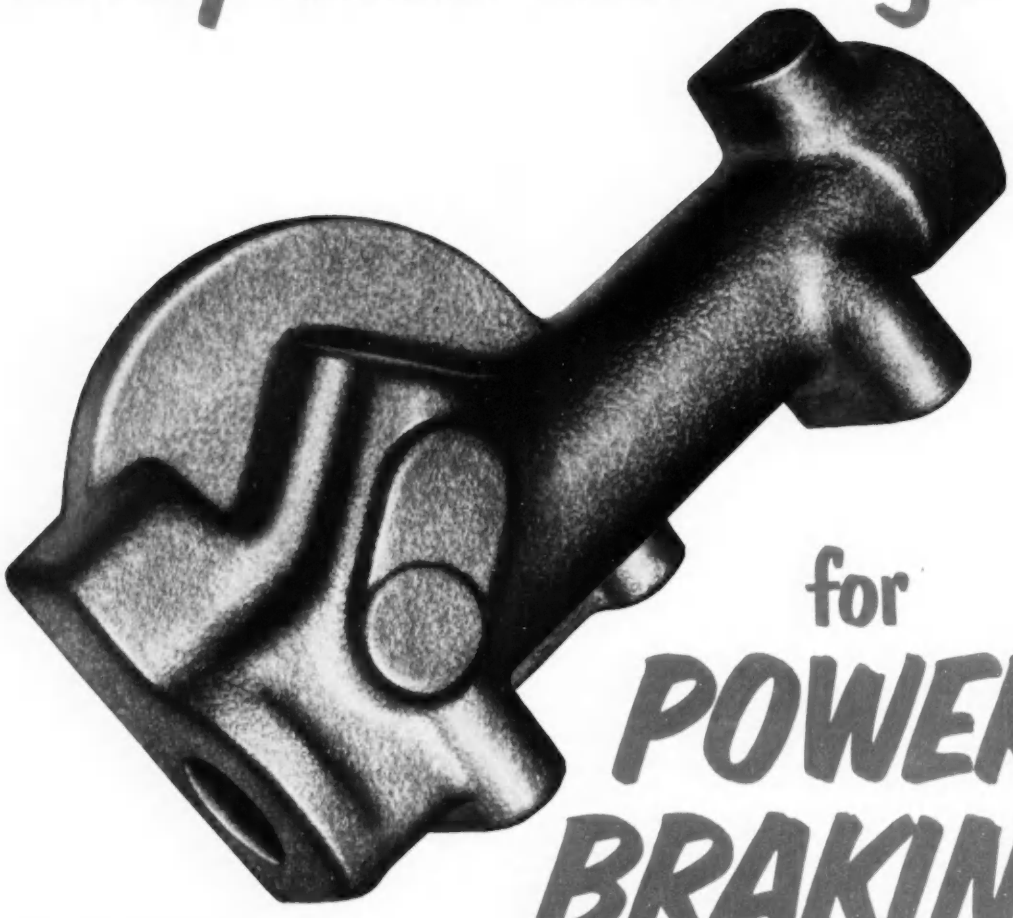
SAGINAW DIVISION: 9771 FRENCH ROAD • DETROIT 13, MICHIGAN

EATON PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

Eaton Permanent Mold Gray Iron Castings—



for POWER BRAKING

Send for your free copy of the 32-page illustrated booklet: "The Eaton Permanent Mold Foundry." It tells the story of Permanent Mold Castings and takes you on a picture-tour of the Eaton Foundry at Vassar, Michigan.

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FOUNDRY DIVISION: 9771 FRENCH ROAD • DETROIT 13, MICHIGAN

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

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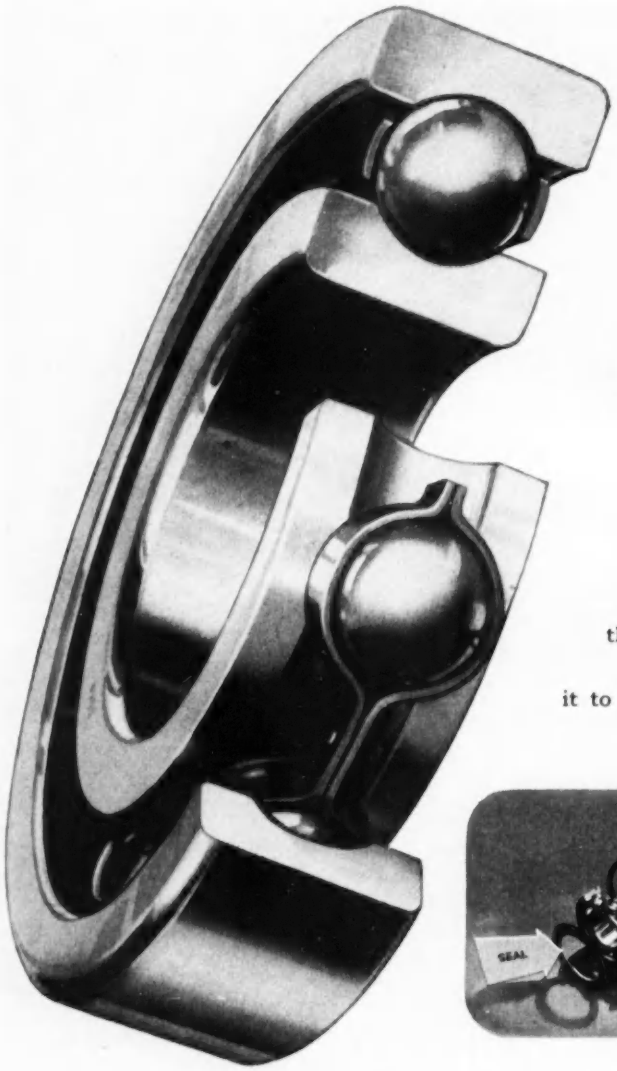

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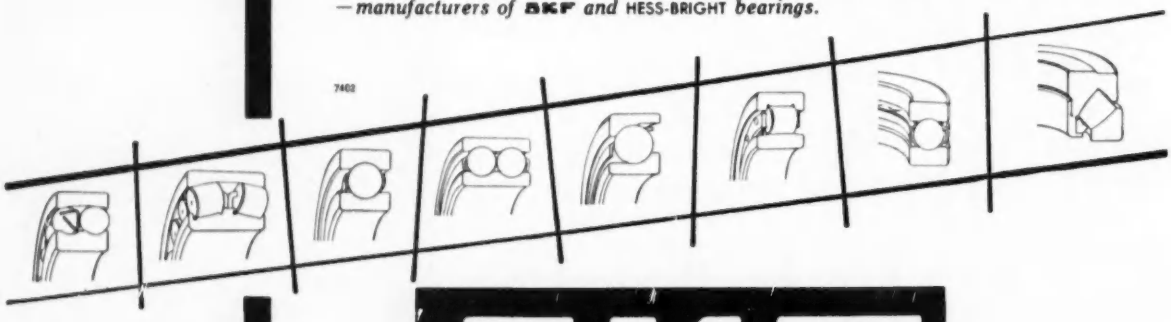
SINGLE ROW DEEP GROOVE BALL BEARINGS

Look at the *contact* between the balls and the deep, continuous groove in each ring of this SKF bearing—contact that enables it to sustain not only radial load, but substantial thrust load, even at very high speeds.

Look further—SKF Single Row Deep Groove Ball Bearings are available with *any combination* of DuPont Fairprene seals, shields and snap rings: shields for excluding dirt; seals for retaining lubricant; snap rings for holding the bearing in lateral position in its housing.

Like all SKF Bearings, they're held well within established tolerance limits, tested for radial runout, carefully cleaned, protected from rust, strongly packaged.

Many SKF bearings are serving industry everywhere because SKF's unmatched Field and Home Office engineering service helped product designers *put the right bearing in the right place.* **SKF INDUSTRIES, INC.,** PHILADELPHIA 32, PA. *—manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.*



SKF'S COMPLETE LINE OF ANTI-FRICTION BEARINGS, PLUS **SKF** ENGINEERING CO-OPERATION, HELPS YOU PUT *THE RIGHT BEARING IN THE RIGHT PLACE.*

SKF®
BALL AND ROLLER BEARINGS

the Record proves that TURQUOISE holds a Needle Point

We sharpened a long, fine drafting point on an Eagle 4H TURQUOISE pencil, snapped it off and used it as the needle in an old-fashioned phonograph.

The point held without crumbling under the weight of the arm and the vibrations of the groove, and played the full record with surprising clarity!

Here is conclusive proof that the 100% "Electronic" graphite in the TURQUOISE lead gives it a particle fineness and compactness that produce non-crumbling, amazingly wear-resisting needle points.

100% "Electronic" graphite also gives unmatched denseness and durability, with the superior smoothness, uniformity and reproduction quality every draftsman dreams of.

PROVE IT YOURSELF: Write for a sample TURQUOISE pencil in any grade you desire, and test it at your own drafting board. Please name your regular supplier and this magazine.

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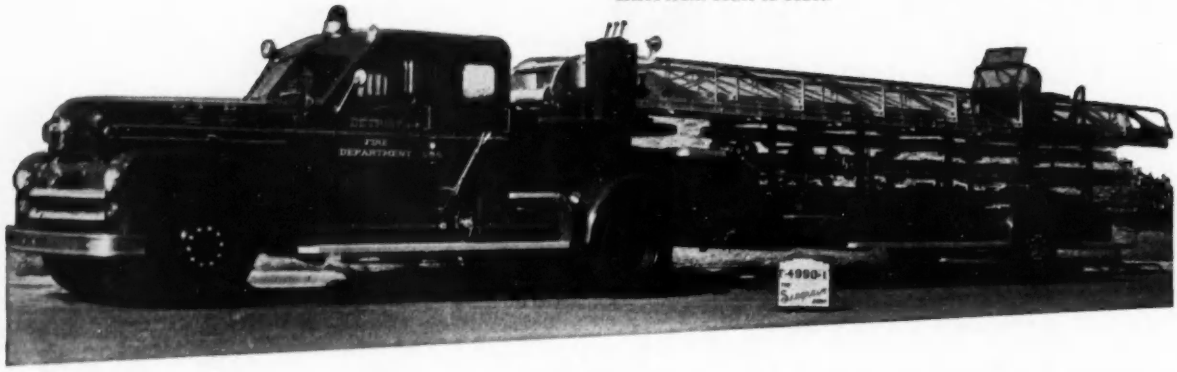
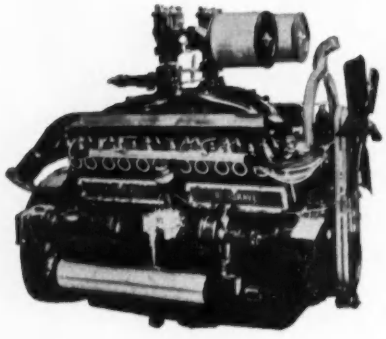
NICKEL-CONTAINING ALLOYS CONTRIBUTE to the dependability of SEAGRAVE Fire Apparatus used in more than 3,000 cities from coast to coast.



How Nickel helps SEAGRAVE



add strength and safety...

cut bulk and deadweight...

minimize maintenance

Built in the SEAGRAVE factory, especially for fire service, this precision built V-12 engine utilizes nickel alloyed iron blocks, heads and pistons produced by ALLYNE-RYAN FOUNDRY CO., Cleveland, Ohio.

This aerial ladder truck – *the entire apparatus, including frame, engine, pumps, controls* – exemplifies the type of complete product made by THE SEAGRAVE CORPORATION of Columbus, Ohio.

With no need of surplus bulk for strength, nickel alloyed bronzes enable SEAGRAVE to produce fine-grained, pressure-tight, machinable castings not only for fittings and small vane type pumps that operate ladders, but also for cast parts in their heavy duty, 4-stage pumps that raise water pressures up to 1000 p.s.i.

Engine castings, including blocks, heads and cylinders are specified in nickel alloyed cast iron to obtain strength and wear-resistance along with machinability in all sections, thick or thin.

Metal ladders and water tanks are fabricated from a low alloy high strength steel containing nickel, to obtain maximum weight reduction in these components without sacrificing strength or safety. Nickel alloyed steel of this type, produced under various trade names by leading steel companies, is used in strip form for ladders, and in sheets for the tanks.

And the unexcelled mechanical properties of case hardened nickel alloyed steel components in Timken rear axle units, complete with brake drums, contribute power-saving capacity to SEAGRAVE apparatus.

Nickel-containing alloys offer significant advantages wherever safety and dependability are essential. When you face a metal problem, send us the details for our suggestions.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

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governors *by the thousands*

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Your problem interests us. We'd like to work with you on the engine controls you need . . . carburetor choking, constant speed control, overspeed protection, overspeed safety cut-off, fuel regulation or related requirements. Tell us your specific problem . . . we'll send a qualified engineer.

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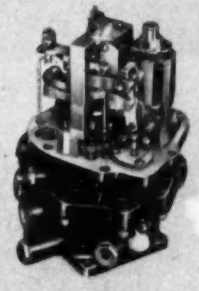
Automatic and Electrimatic carburetor chokes as original equipment or replacement. *19 million chokes in the past 17 years!*



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Hydraulic booster controls for heavy-duty vehicles and aircraft.

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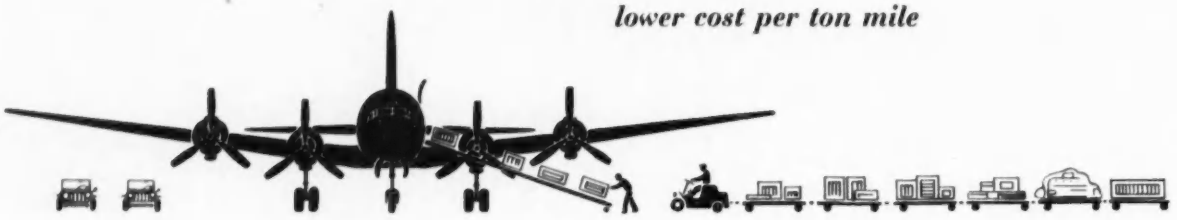
5,000 cubic feet of cargo space...

300 m.p.h. cruising speed...

lower cost per ton mile

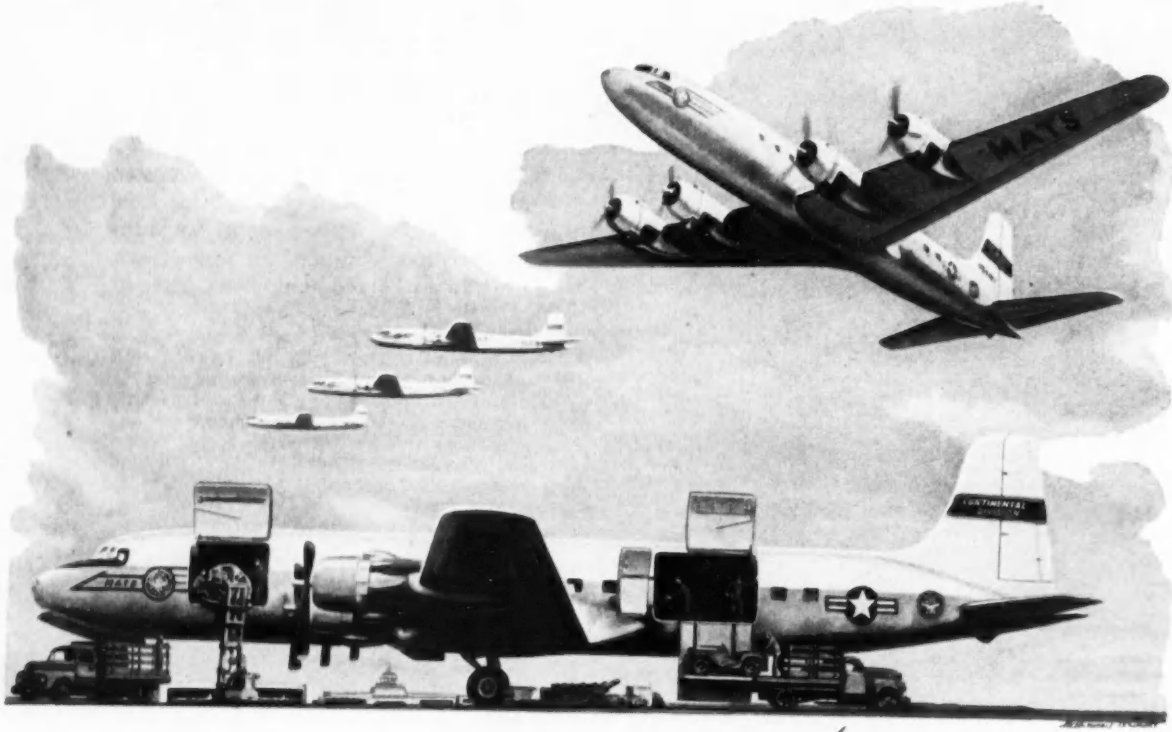


___the Douglas Liftmaster

Flying for the Air Force as C-118A and for the Navy as R6D, the Douglas Liftmaster delivers 14-ton payloads 2850 miles non-stop—at the lowest cost.

Outside, Liftmaster shows the same aerodynamic lines as its commercial counterpart, the DC-6A. Inside, there's room for 28,700 pounds of mixed freight. Large front and rear doors service cargo compartments. A self-powered loading elevator lifts 4,000 pounds from truck bed height to cabin floor level . . . fits either door. Through this combination of speed and utility, Liftmaster achieves the ultimate in long-range, low-cost transportation of military matériel.

Performance of the Liftmaster is further proof of Douglas leadership in aviation. Planes, produced in quantity *to fly faster and farther with a bigger payload*, are a basic rule of Douglas design.



Depend on *DOUGLAS* First in Aviation

"DETROIT" UNIVERSAL JOINTS...

...Reflect the Responsibility of Leadership

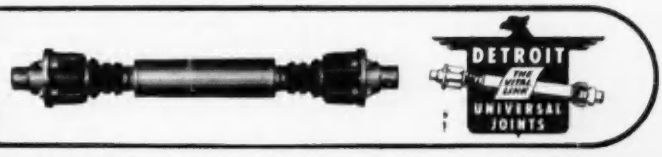
America and America's automotive manufacturers know that leadership is retained only by assuming responsibility for progress and by uncompromising adherence to standards of quality.

As a leader in our field, we pioneered and developed "DETROIT'S" outstanding Ball and Trunnion Joints—combining the exclusive advantages of anti-friction slip motion with self-aligning bearings.

Result: Longer life for the entire drive train... and a better riding automobile.

We will continue to pioneer improvements in universal joints as we have in the past, and will zealously guard the engineering and manufacturing reputation which has resulted in the selection of "DETROIT" Universal Joints as original equipment on millions of cars and trucks.

DETROIT
UNIVERSAL JOINTS



UNIVERSAL PRODUCTS COMPANY, Inc., Dearborn, Michigan

Wagner Air Brakes...

"maintain uniform dependable service that's *safe* and *sure*..."

says: Stanley V. Osman

Purchasing Agent

SCHERER FREIGHT LINES, INC., OTTAWA, ILLINOIS

With WAGNER AIR BRAKES on the vehicles you manufacture users are assured of safety-tested perfection that's backed by over twenty-five years' experience in manufacturing brakes and complete brake systems. They can enjoy the same assurance of safety and lower maintenance costs as Stanley V. Osman of Scherer Freight Lines, Inc., reports.

Wagner Air Brakes are now available as original equipment from leading manufacturers of trucks and buses. These manufacturers know that the ever-increasing demand by transport operators requires them to install an air brake system that's safe... sure... and economical to operate—that's why so many prefer WAGNER.

Take a tip from men like Stanley Osman —Get all the facts. It will pay you to include Wagner Air Brakes as standard equipment on the vehicles you manufacture. Write today for complete information and free copy of Bulletin KU-201A.

Scherer FREIGHT LINES, INC.

GENERAL OFFICES
OTTAWA, ILLINOIS

400 SCHERER TRUCKS AND TRAILERS — SERVING OVER 600 COMMUNITIES

October 2, 1952

Wagner Electric Corporation
6400 Plymouth Avenue
St. Louis 14, Missouri

Gentlemen:

As purchasing agent for Scherer Freight Lines, Inc., I check with our drivers and mechanics to find out what equipment is best suited for their needs. When it comes to air brake systems used in our operation, they agree that Wagner Air Brakes maintain uniform dependable service that's safe and sure and also require little or no maintenance in our shop.

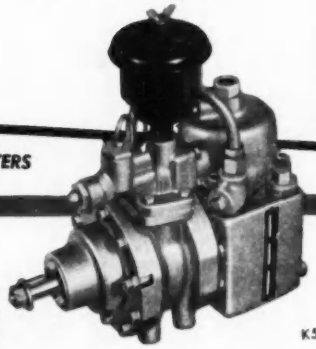
Quentin Pletsch, our superintendent of Maintenance, reported that he hasn't had a single case of road failure or repair trouble on some units equipped with Wagner Air Brakes that have passed the 100,000 mile mark of profitable hauling.

My reasons for specifying Wagner Air Brakes when ordering new equipment is because our past experience shows that Wagner Air Brakes help us lower maintenance expenditures. Our drivers feel safe because they know they have adequate stopping power at all times.

Sincerely,

Stanley V. Osman
Purchasing Agent

SVO hk



WAGNER AIR BRAKE USERS ARE OUR BIGGEST BOOSTERS

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K53-4A

HERE'S A TRUCK TIRE RIM THAT'S

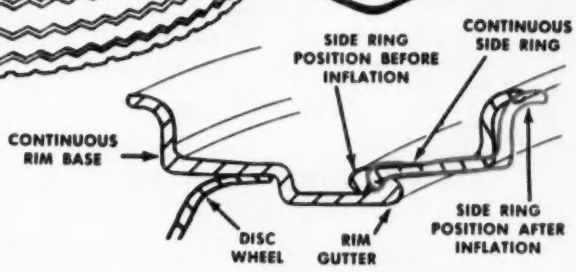
Really Safe...

IT'S THE **Firestone**

RH-5° ADVANCED RIM

The Firestone RH-5° Advanced Rim is a two-piece disc wheel assembly with a continuous side ring that locks at the rim gutter when the tire is inflated, eliminating any possibility of a ring blow-off. As the tire is inflated and air pressure builds up in the tire, the tire beads are forced outward onto the 5° tapered bead seats. This motion moves the side ring outward until it becomes centered and safely locked to the rim gutter, in the position shown in red on the sketch. When securely locked in this position, a ring blow-off is absolutely impossible because the diameter of the side ring is less than the diameter of the rim gutter.

Truck operators recognize the safety features of Firestone RH-5° Rims and insist that the trucks they buy be equipped with these extra safe, dependable rims. For further information on how Firestone RH-5° Advanced Rims will keep drivers sold on **your** trucks, write to Firestone Steel Products Company, P. O. Box 2639, Akron 1, Ohio.



America's Future Progress Depends on Better and Safer Highways

FIRESTONE RH-5° RIM

A new 20-minute movie has been prepared showing how to operate the Firestone RH-5° Advanced Rim and telling why, when completely assembled, the side ring can't blow-off. Copies are available for showing to your service departments. Write to Firestone Steel Products Company, Akron, Ohio, for further information.

FIRESTONE STEEL PRODUCTS COMPANY
AKRON, OHIO

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Above-average efficiency . . . . . at no increase in cost

Normally you'd expect to pay a premium for the precision found in Rollway's TRU-ROL. Not so, however. These long-life steel-cage bearings are competitively priced. Their exceptional performance and low cost are the result of three distinctive Rollway advantages:

FIRST Advanced metallurgical facilities and mass production by modern, high-speed, high-precision machinery.

SECOND Experience since 1908—during good times and bad—in the practical application of cost-cutting methods.

THIRD Tru-Rol's contoured guide lips which insure constant roller alignment and extended life. They prevent undue wear caused by skew, slide and end-rub . . . encourage cooler operation by spreading a thin film of lubricant evenly over the rollers.

ENGINEERING SERVICE . . . Rollway TRU-ROL Bearings are available with steel cages or steel-segment retainers—a choice that fills a wide range of tractor requirements at the lowest possible cost. If you have a particular problem, contact us. A Rollway engineer will be available for consultation with you —without obligation, of course. Rollway Bearing Company, Inc., Syracuse 4, N. Y.

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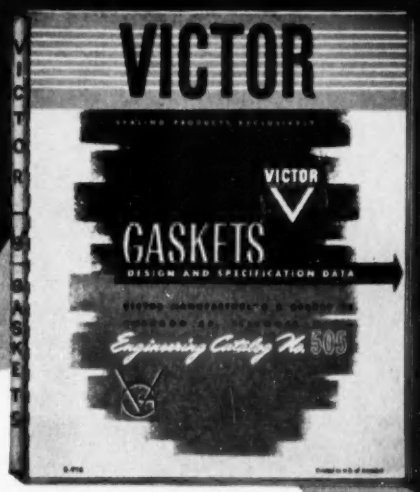
New Complete Guide to Gasket Materials

meeting SAE-ASTM Specifications

For the Design Engineer *



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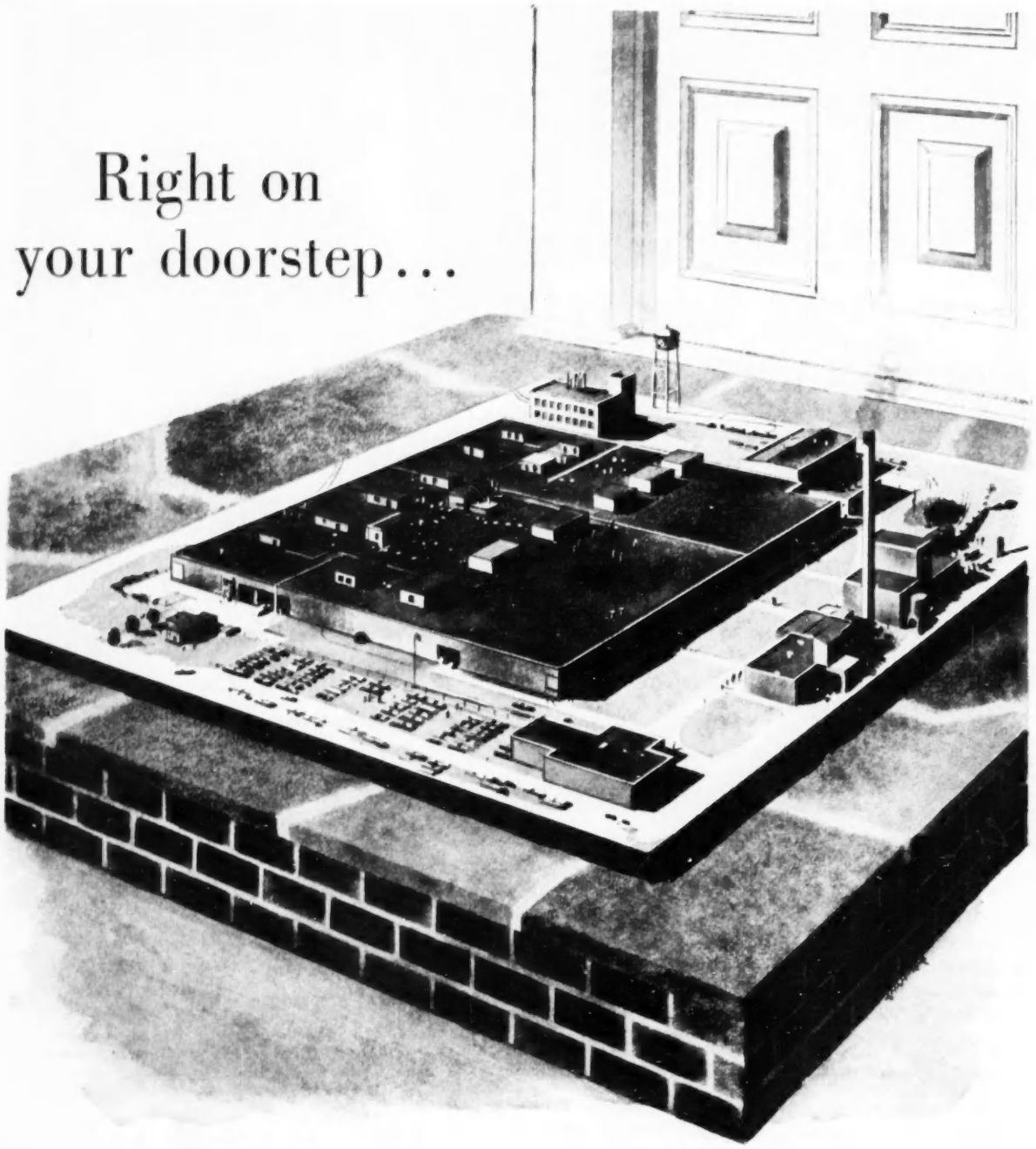

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"U.S." Research perfects it
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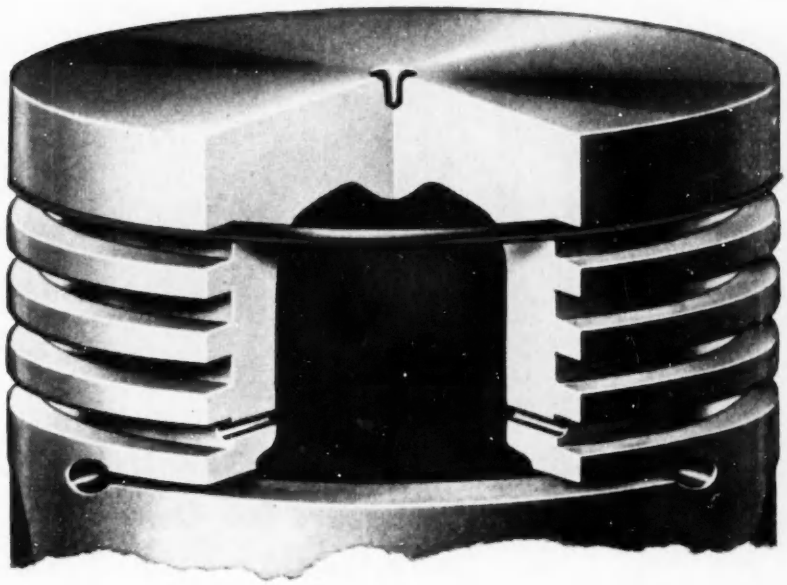
ARMOR-PLATE PROTECTION FOR TOP-RING GROOVE STRETCHES PISTON LIFE TO AS MUCH AS 200,000 MILES!



Sealed Power GI-60 Groove Insert

The only dependable, economical answer to top-ring groove wear

Sealed Power has found the only satisfactory way to protect the top-ring groove—the groove that takes the greatest heat and pressures—the groove that gets the least lubrication.

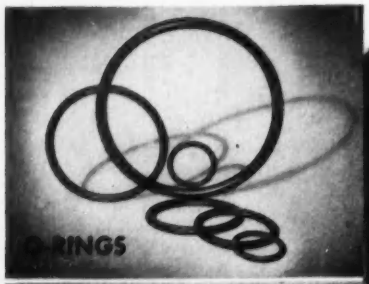
The Sealed Power GI-60 Insert is made of heat-treated spring steel. It is permanently anchored in a special recess at the top of the ring groove, cut there by a special Sealed Power tool. The top-ring groove, with GI-60 inserted, is exactly the same dimensions as before—the dimensions prescribed by the engine manufacturer, to take the size ring the engine originally called for.

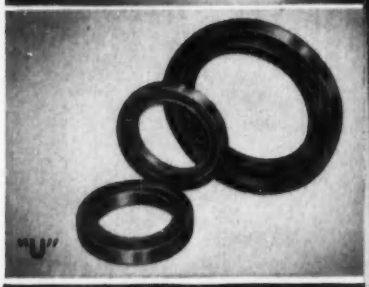
GI-60 works equally well in new or resized pistons. It is recommended by many car and truck manufacturers. Letters from fleet operators who have adopted it for both new and used replacement pistons report that GI-60 has increased piston life to an average of more than 200,000 miles. It is an outstanding and exclusive Sealed Power development. Its cost is low, out of all proportion to its benefits.

Sealed Power Corporation

MUSKEGON, MICHIGAN

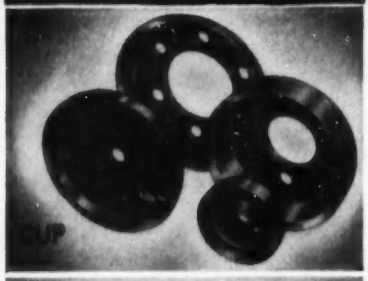
Sole manufacturers of KromeX Ring Sets, MD-50 Steel Oil Ring, Full-Flow Spring, and GI-60 Groove Inserts. Leading producer of Automatic Transmission Rings and Non-Spin Oil Rings

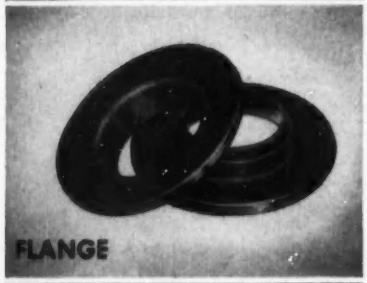




V-PACKINGS

Made of leather or rubber. A complete mechanical seal, installed in sets in a recess on cylinder wall or piston head. Sealing areas or "stack height" form dynamic seal inside and outside. Male and female adapter rings required, metal preferred. No expanders are needed but spring tension is sometimes employed.





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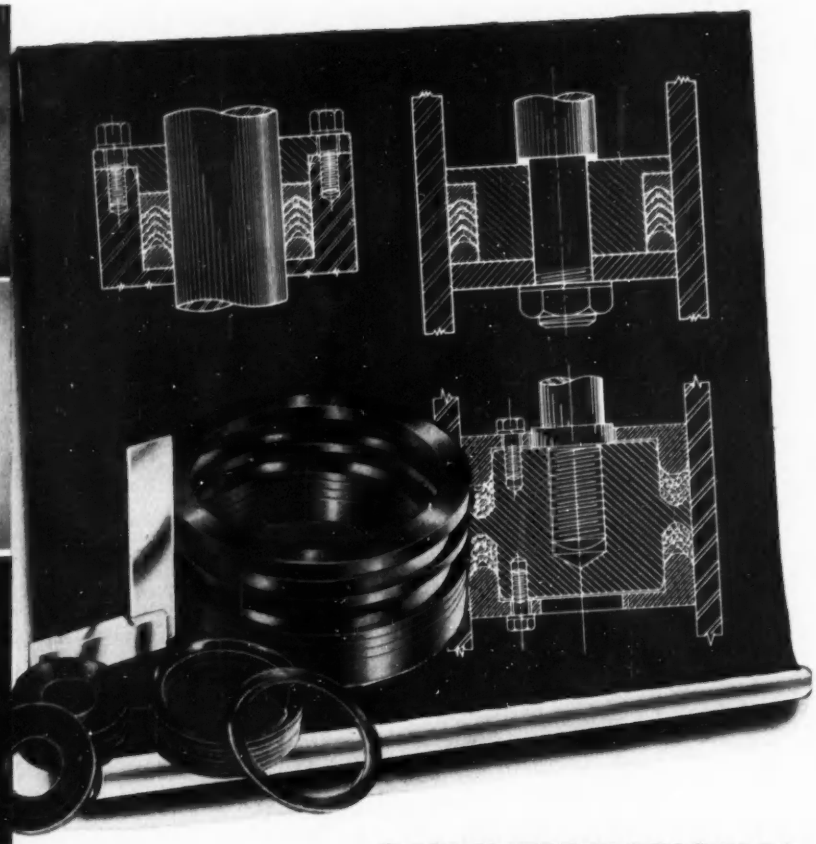

G&K-INTERNATIONAL

Headquarters for Original Equipment and Replacement Packings

More and more well-known industrial concerns are coming to G&K-INTERNATIONAL for *all* their packings needs: Original Equipment and Replacement.

Why? Because at G&K-INTERNATIONAL there is no compromise with quality. These customers (and you, too) demand packings that live up to the specs and arrive on schedule. It's as simple as that — but it's not that simple.

There are four parts to every packings problem: 1. The packings design and dimensions. 2. The material — leather and its impregnants, or basic rubbers and their formulation. 3. Developing these to meet exacting requirements in modern hydraulic and pneumatic applications. 4. Manufacturing these packings uniformly — and on schedule.

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G&K GRATON AND KNIGHT INTERNATIONAL

GRATON & KNIGHT COMPANY
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a better life...
in California

There's more to a job at Lockheed than eight hours' work a day. There's the friendly spirit of progress—of getting things done—that makes work so much more stimulating. There's the better life you live—just because you live in Southern California. There's the future that offers you and your family security and advancement with the *leader in aviation.*

New design ideas spring from spontaneous conferences such as these

Better Working Conditions

On the job, you work in an atmosphere of vigorous, progressive thinking. Personal initiative, new ideas are encouraged. Frequent conferences iron out problems, keep work rolling smoothly. You work with top men in your profession—as a member of the team known for leadership.

Outdoor life prevails in Southern California the year around

Better Living Conditions

Every day, you get a "bonus" at Lockheed—in the better living conditions. The climate is beyond compare. Recreational opportunities are unlimited. Golf, fishing, the patio life at home can be yours 12 months a year. And your high Lockheed salary enables you to take full advantage of the climate and recreational opportunities.

Special training courses prepare you for promotion

Better Future

You have a *future* at Lockheed—not just a job. For Lockheed is building planes for defense, planes for the world's airlines. The planes of tomorrow are being designed today in Lockheed's long-range development program.

Special training courses in management and various phases of aeronautical engineering help prepare you for the future and promotion. Ask any of the 5,000 who wear 10-year pins whether or not there's a career and security at Lockheed.

To Engineers with Families:

Housing conditions are excellent in the Los Angeles area. Thousands of rental units are available. Huge tracts for home ownership are under construction now. Thousands of homes have been built since the last war. Lockheed counselors help you get settled. Educational facilities also are excellent. The school system offers your children as fine an education as can be obtained anywhere. Elementary and high schools are conveniently located. Junior colleges and major universities abound—21 are in the Los Angeles area.

Lockheed also offers:

Generous travel allowances • Outstanding Retirement Plan • Vacations with pay • Low-cost group life, health, accident insurance • Sick Leave with pay • Credit Union, for savings and low-cost financing • Employees' Recreation Clubs • Regular performance reviews, to give you every opportunity for promotion • On-the-job training or special courses of instruction when needed.

IMMEDIATE OPENINGS FOR:

Aerodynamicists
Airplane Specifications Engineers
Ballistics Engineers
Design Engineers "A" & "B"
Engineering Drawings Checkers
Flight Test Engineers "B"
Flutter and Vibration Engineers
Instrumentation Engineers
Jr. Engineers—Draftsmen "A"
Jr. Engineers—Draftsmen "B"
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Research Engineers
Scientists
for systems analysis and military operations research
Service Engineers
Servomechanism Engineers
Stress Engineers
Structures Engineers
Weight Engineers

Send today for free illustrated brochure describing life and work at Lockheed in Southern California. Use this handy coupon.

Mr. M. V. Mattson, Employment Manager, Dept. SAE-4

LOCKHEED Aircraft Corporation Burbank, California

Please send me your brochure describing life and work at Lockheed.

My Name _____

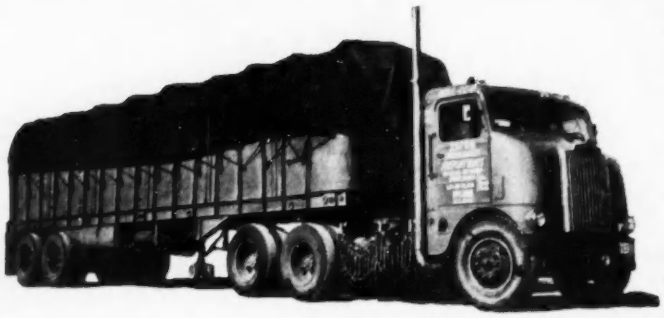
My Street Address _____

My City and State _____

My Field of Engineering _____

Aircraft experience is not necessary for a job at Lockheed. It's your general engineering background—your aptitude—that counts. Lockheed will train you to be an aircraft engineer—at full pay.

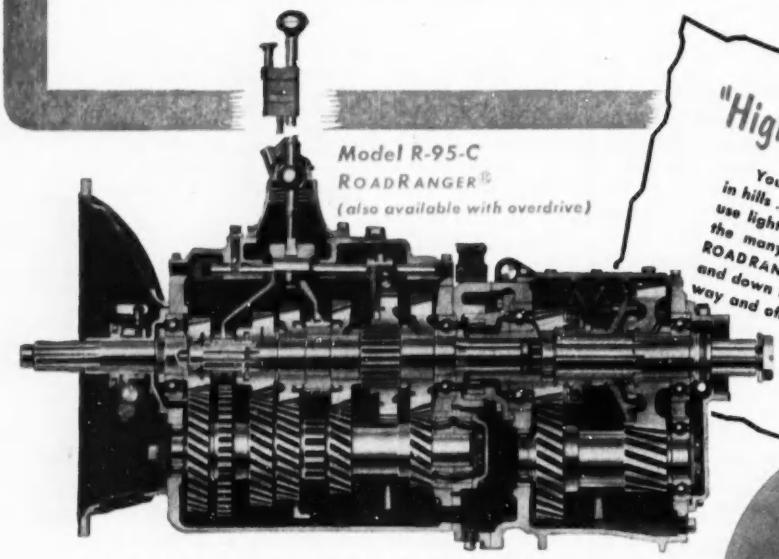
Performance proved with the FULLER ROADRANGER®!



Consolidated Freightways, Inc., of Portland, Ore., is operating 78 Fuller ROADRANGERS out of their Chicago terminal. Each ROADRANGER-equipped White-Freightliner averages 14,000 miles each month on the "mainline" route to and from the West Coast.

Using 165 hp Cummins Diesels, governed at 1850 rpm, and hauling 59,000 lbs. gross, they are standardizing on the Fuller ROADRANGER Model R-950-C (with overdrive) to step up time in hills and traffic, get more freight on the payload axle.

Fuller ROADRANGER Transmissions pay off for Consolidated in low maintenance costs as well as high average trip speeds—and the operators all sing their praises.



Model R-95-C
ROADRANGER®
(also available with overdrive)

"Higher Average Speed in Hills"

You hear it everywhere—"higher average speed in hills . . . less driver fatigue . . . more payload . . . use lighter engines . . ." And that's just a few of the many things they're saying about the Fuller ROADRANGER. North, east, south, west . . . in up and down hauling, in dense traffic . . . on the highway and off . . . fleet operators are turning to the new efficiency of this 10-speeds-with-one-lever transmission.

They like the ROADRANGER because of these advantages:

1 No gear splitting—10 selective gear ratios, evenly and progressively spaced. **2** Easier, quicker shifts—28% steps—one shift lever controls all 10 forward speeds. **3** Higher average road speed—engine operates in peak hp range with greater fuel economy. **4** Less driver fatigue—1/3 less shifting. **5** Range shifts pre-selected—automatic and synchronized. **6** More compact than other 10-speeds. **7** More cargo on payload axle.

Fuller TRANSMISSIONS®

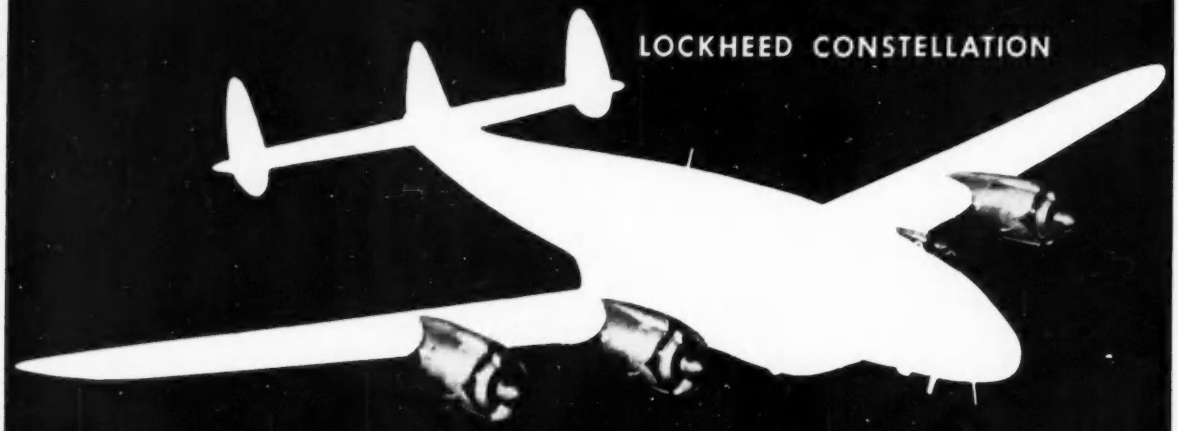
FULLER MANUFACTURING COMPANY (Transmission Division), KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wis. • WESTERN DISTRICT OFFICE (SALES & SERVICE—BOTH DIVISIONS), 1060 E. 11th Street, Oakland 6, Calif.

SuVeneer® CLAD METALS

Prospecting for more profitable product fabrication? You're in luck when you find how **SuVeneer** Clad Metals pan-out on your applications . . . in savings of expensive non-ferrous materials, in ease of fabrication, and in improved product performance. **SuVeneer** Clad Metals are composites of genuine copper, or brass, or nickel, bonded inseparably to plain strip steel on one or both sides. • You save from 70% to 80% of the solid strategic metals, while enjoying *all* their surface advantages. Write!

Superior Steel
CORPORATION
CARNEGIE, PENNSYLVANIA



We show you this picture of the Lockheed Constellation this way -- to illustrate to you what Rohr is famous for: Building power packages -- power packages for the Lockheed Constellation and other world-famous commercial and military planes. Of course, the Rohr aircraftsmen do more than this. Currently they are producing more than 25,000 different parts for all types of airplanes.

power packages by

ROHR

WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES

ROHR
AIRCRAFT CORPORATION CHULA VISTA AND RIVERSIDE CALIFORNIA

Make Your Own Hose Lines

AEROQUIP HOSE AND FITTINGS ARE MATCHED FOR GUARANTEED PERFORMANCE

● No skill or special training is required to assemble Aeroquip Flexible Hose Lines by hand *in a matter of minutes!* YOU CUT COSTS because Aeroquip fittings are detachable and may be used again and again. YOU REDUCE INVENTORY because with Aeroquip bulk hose and a few fittings you can fill practically all your hose line requirements. YOU REDUCE DOWNTIME because with Aeroquip on hand, quick hose line replacements are available at all times.

Cut hose to length with hacksaw; screw into socket.

Oil nipple and inside of hose liberally.

Screw nipple into socket and hose.

Install fitting on other end; hose line is ready for use.

Aeroquip

REG. TRADE MARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

SALES OFFICES: BURBANK, CALIF. • DAYTON, OHIO • HAGERSTOWN, MD. • HIGH POINT, N. C. • MIAMI SPRINGS, FLA.
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AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

HYDRAULICS FOR MOBILE EQUIPMENT

Mobile Equipment News

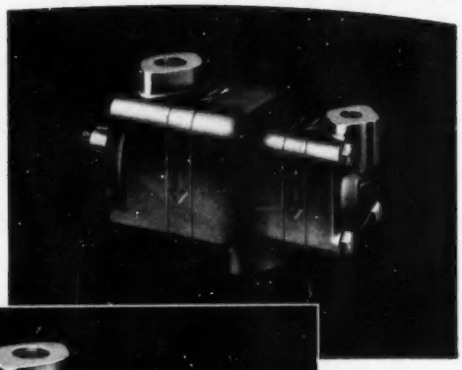
IMPROVES PERFORMANCE • CUTS COSTS

VOL. 3 — VICKERS INCORPORATED, DETROIT, MICHIGAN — NO. 3

26 MORE VICKERS DOUBLE PUMPS NOW IN PRODUCTION

OFFER MANY REAL BENEFITS WHEN TWO HYDRAULIC CIRCUITS ARE USED ON MOBILE EQUIPMENT

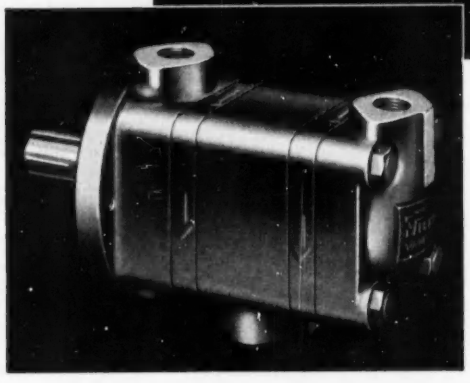
These double pumps are becoming increasingly popular wherever two machine components must operate simultaneously at different speeds and/or operating pressures. They also prevent all possible chance of one operation interfering with another.



(Right) Series V-2200 Double Pump in 10 sizes from 3.2 to 32.6 gpm combined delivery.

TWO PUMPS IN TANDEM

These are essentially two pumps in a single housing and driven by a common shaft. Independent pressure control must be provided as there is a separate pressure outlet for each pump.



(Left) Series V-3200 Double Pump in 16 sizes from 11.9 to 51.1 gpm combined delivery.

LONGER PUMP LIFE RESULTS FROM HYDRAULIC BALANCE

Like Vickers Vane Type Single Pumps, these double pumps have the exclusive Vickers "Hydraulic Balance" that eliminates pressure-induced bearing loads and results in longer pump life.

NO-LOAD STARTING

At rest and normal starting speeds, the sliding vanes are retracted; only after engine fires do vanes extend and pumping begin.

COMPACT AND EASILY INSTALLED

Greater mounting adaptability because of minimum space requirement, 3 mounting styles, optional and independent piping connection positions, shaft drive in either direction.

TOP PERFORMANCE THROUGHOUT PUMP LIFE BECAUSE OF AUTOMATIC WEAR COMPENSATION

Radial compensation for normal wear and temperature differentials is provided by the movement of the vanes in the rotor slots. (Wear is minimized because all parts are lubricated by the oil under pressure.)

Axial compensation is by means of a pressure plate held to optimum running clearance by pressure from the system.

Automatic compensation eliminates need for "run in" . . . efficiency is maximum the first time the pump is started. It also assures maximum delivery over a very long life and with wide oil temperature change.

ASK FOR NEW BULLETIN M-5101

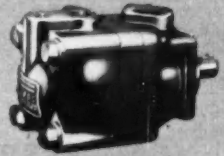
VICKERS Incorporated
DIVISION OF THE SPERRY CORPORATION
1440 OAKMAN BLVD. • DETROIT 32, MICH.

Application Engineering Offices: ATLANTA • CHICAGO (Metropolitan) CINCINNATI • CLEVELAND • DETROIT • HOUSTON • LOS ANGELES (Metropolitan) • NEW YORK (Metropolitan) • PHILADELPHIA (Metropolitan) • PITTSBURGH • ROCHESTER • ROCKFORD • SEATTLE TULSA • WASHINGTON • WORCESTER

6230

OTHER VICKERS DOUBLE PUMPS FOR MOBILE EQUIPMENT

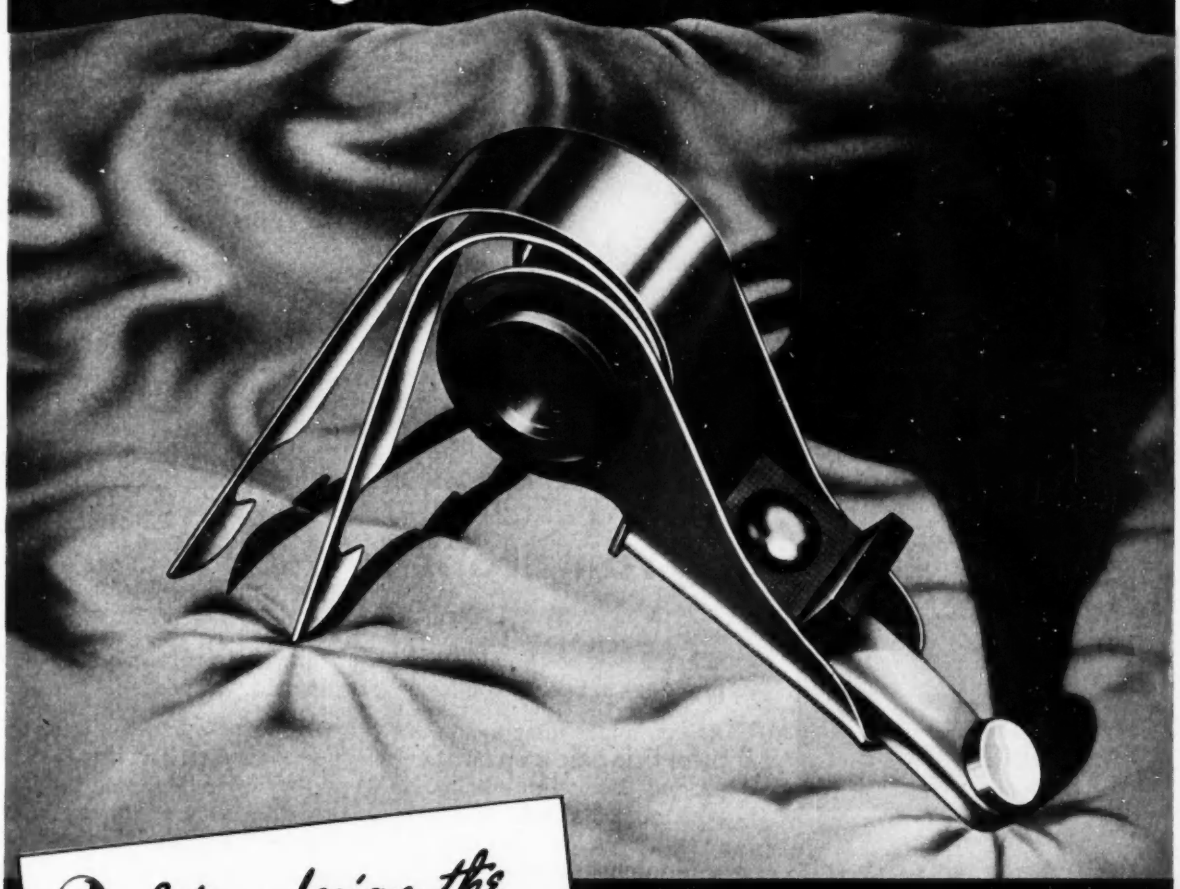
(Left) Series V-4200 Double Pump in 6 sizes from 30.7 to 70.2 gpm combined delivery.



(Right) Series V-5200 Double Pump in 6 sizes from 48.8 to 89.4 gpm combined delivery.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

The Most Satisfactory IGNITION CONTACT Ever Designed!



Let us design the Contacts for your equipment—or we will make them to your specifications

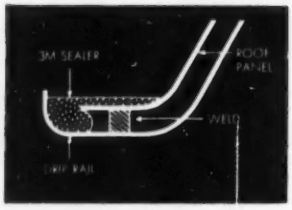
ECHLIN
Ignition

A PRODUCT OF ECHLIN

CONTACTS
COILS · CONDENSERS
& OTHER AUTOMOTIVE
ELECTRICAL PARTS

ECHLIN MANUFACTURING COMPANY • DEPT. SAJ, 200 EAST STREET, NEW HAVEN 5, CONN.

Keeping raindrops in the groove



When a new method of attaching drip rails to cars was first proposed, a new type of sealing compound was needed.

As you might imagine, a sealer for this purpose had to do far more than just keep out the rain. For example, to fit into current production methods, this sealer had to be flowed into position . . . where it would stay. It had to be cured during paint oven processing. And it could not "bleed" through paint applied over it.

3M helped automotive engineers solve this problem by coming up with a water- and weather-resistant sealer that contains *all* of the required properties. Why not consider 3M's Drip Rail Sealer for your needs?

See what adhesives can do for you . . .

To learn more about this sealer and 3M's countless other products used extensively in the automobile industry, write for 3M's free automotive booklet. Address your request to Dept. 94, 411 Piquette Avenue, Detroit 2, Michigan.

3M COMPANY

MINNESOTA MINING AND MANUFACTURING COMPANY

ADHESIVES·COATINGS·SEALERS

ADHESIVES AND COATINGS DIVISION • 411 Piquette Ave., Detroit 2, Michigan
GENERAL SALES OFFICES: ST. PAUL 6, MINN. • EXPORT: 270 PARK AVE., NEW YORK 17 • IN CANADA: LONDON

MAKERS OF "SCOTCH" BRAND PRESSURE-SENSITIVE ADHESIVE TAPES • "SCOTCH" BRAND SOUND RECORDING TAPE • "SCOTCHLITE" BRAND REFLECTIVE SHEETINGS • "3M" ABRASIVE PAPER AND CLOTH • "3M" ADHESIVES AND COATINGS • "3M" ROOFING GRANULES • "3M" CHEMICALS

YOU'LL NEVER SEE

a duck flying blind

Ducks make a habit of knowing where they're going. Long before the vacation trip to the sunny clime, their bags are packed, time-tables checked and reservations made. Then, quacks in tune, they're off.

Building a new product can be duck soup when you know where you're going and how you're going to get there. Here then is where it pays to *plan ahead*... taking the time to investigate the use of castings in lieu of more costly machined parts. Castings, produced by Campbell, Wyant and Cannon, give you greater freedom of design, resistance to wear and easier machinability—all at much less cost.

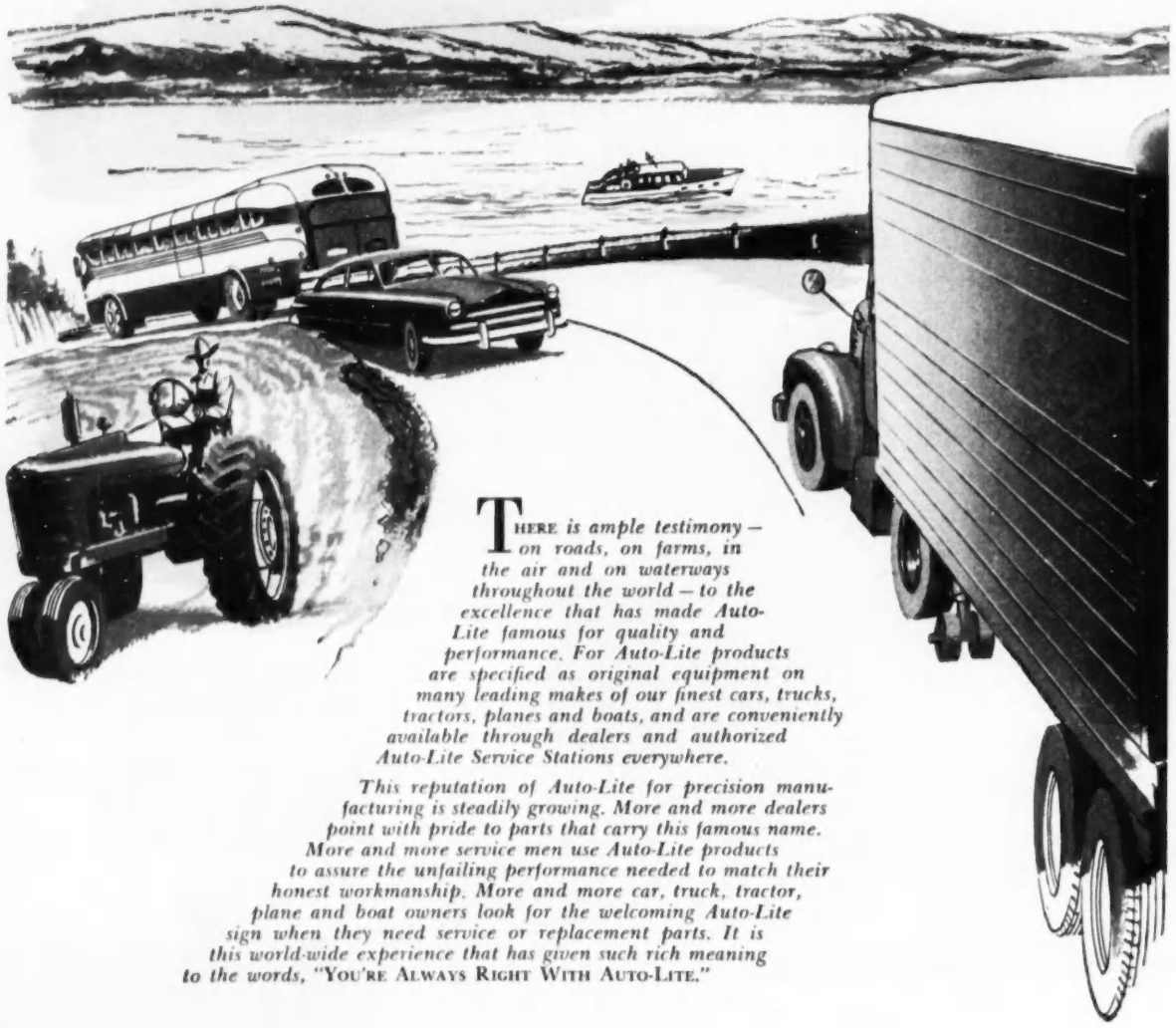
Why not let CWC do a job and maybe next time you can wing along south with the ducks, leaving your worries behind—with us.

CAMPBELL, WYANT AND CANNON
FOUNDRY COMPANY
Muskegon, Michigan

CWC

Since 1908

Serving the world's constant demand for better transportation!



THERE *is ample testimony — on roads, on farms, in the air and on waterways throughout the world — to the excellence that has made Auto-Lite famous for quality and performance. For Auto-Lite products are specified as original equipment on many leading makes of our finest cars, trucks, tractors, planes and boats, and are conveniently available through dealers and authorized Auto-Lite Service Stations everywhere.*

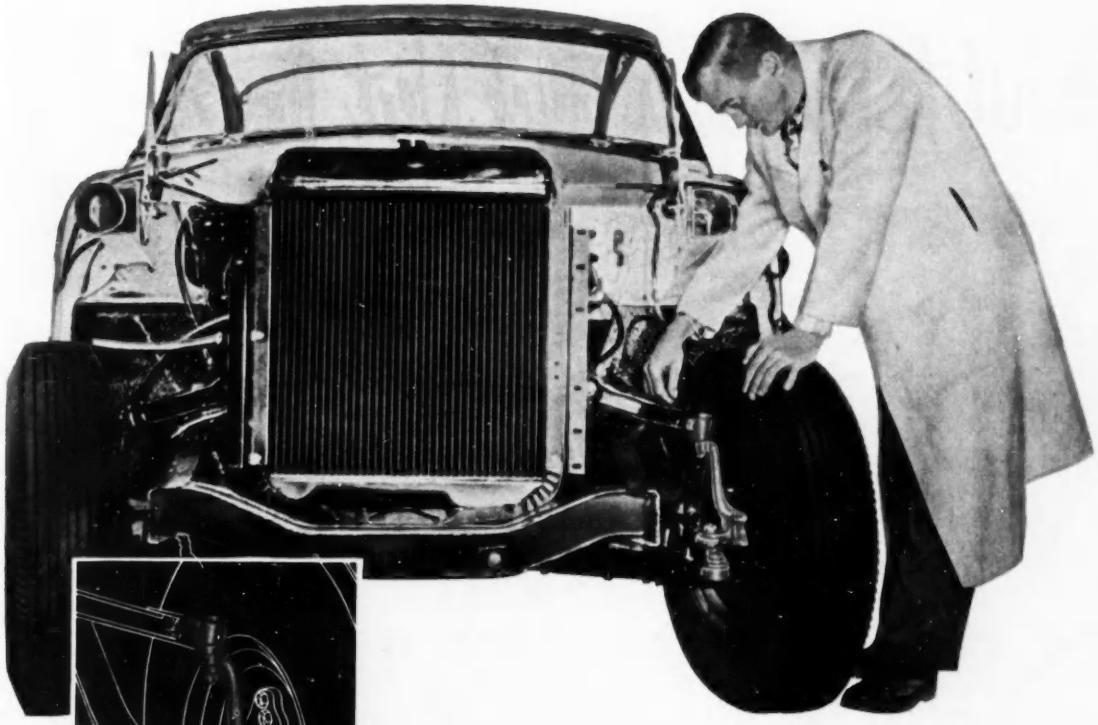
This reputation of Auto-Lite for precision manufacturing is steadily growing. More and more dealers point with pride to parts that carry this famous name. More and more service men use Auto-Lite products to assure the unfailing performance needed to match their honest workmanship. More and more car, truck, tractor, plane and boat owners look for the welcoming Auto-Lite sign when they need service or replacement parts. It is this world-wide experience that has given such rich meaning to the words, "YOU'RE ALWAYS RIGHT WITH AUTO-LITE."

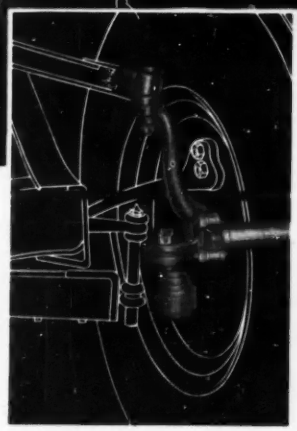
AUTO-LITE

Manufacturers of...

BATTERIES • BUMPERS • FUEL PUMPS • HORNS • GENERATORS
LIGHTING UNITS • SPEEDOMETERS • SPEEDOMETER CABLE
SWITCHES • STARTING MOTORS • INSTRUMENTS & GAUGES
IGNITION UNITS • MOULDED PLASTICS • WINDSHIELD WIPERS
WINDOW LIFTS • SEAT MOVING MECHANISMS • HUB CAPS
WIRE & CABLE • SPARK PLUGS • METAL FABRICATED
ASSEMBLIES • GRAY IRON CASTINGS • ZINC &
ALUMINUM BASE DIE CASTINGS

WORLD'S LARGEST INDEPENDENT MANUFACTURER OF AUTOMOTIVE ELECTRICAL EQUIPMENT





Easy and uniform steering

with Thompson's Front Suspension Ball Joint

"Easy Steering" comes next to safety in the design of steering mechanism for modern cars. The advance designs—high road speed—increased loads on suspension and linkage—reduced space due to front wheel brakes—increased movement of front wheels—air cushion tires—all increase steering problems. "Easy Steering" is so important to motorists today that they demand it—even if they have to pay extra.

Thompson's Front Suspension Ball Joint gives that easy steering with safety. It gives easy ride and stability at high speed.

In a recent survey of owners of cars equipped with front suspension ball joint, it was found to be the best liked mechanical feature.

We invite you to investigate this most advanced improvement in front end suspension in 20 years. Write, wire or phone Thompson Products, Inc., Detroit Division, 7881 Conant Ave., Detroit 11, Michigan.

BENEFITS OF BALL JOINT SUSPENSION:

1. More space under the hood for wider engines
2. Eliminates front suspension bind.
3. Gives better steering and handling
4. Increases service life many times
5. Greatly reduces front end overhaul time
6. Reduces lubrication points from 12 to 4 per car
7. Cuts assembly time—on production line or garage
8. Eliminates removing front wheels, bushings, draining brakes and realigning wheels when servicing front end

You can count on

Thompson Products

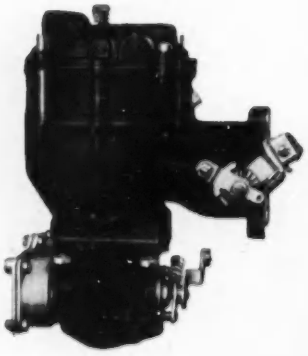
DETROIT DIVISION

Manufacturers of Automotive, Aircraft and Industrial Parts

Will he Buy Your Truck Next Time?

IT ALL DEPENDS ON PERFORMANCE and PERFORMANCE DEPENDS ON

Zenith CARBURETORS



No manufacturer could long exist in the competitive commercial vehicle field without drawing heavily on previous owners for new vehicle sales. It is perfectly obvious, no owner would buy the same make vehicle again and again unless it has delivered satisfactory performance. Therefore, it is just good business to see that every component contributes its share toward building owner loyalty. That's why manufacturers whose vehicles are Zenith* equipped measure carburetion costs in lasting terms rather than initial expense. In the field of heavy-duty carburetion, one name, Zenith, has stood for lasting satisfactory performance for over a quarter of a century. Zenith's rugged construction, strong idling, freedom from stalling and response to every demand make it the engineers' choice. For good will, it's good business to specify the best—Zenith for lasting performance.

*REG. U.S. PAT. OFF.

ZENITH CARBURETOR DIVISION OF
696 Hart Avenue • Detroit 14, Michigan

Bendix
AVIATION CORPORATION

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PUMPS

for FLUID POWER

The most comprehensive range of types, capacities and pressures for industrial, machine tool, materials handling, mining, oil well and aviation applications. Also hydraulic motors, cylinders and valves to develop complete hydraulic circuits.

for HANDLING LIQUIDS

An exceptionally broad range of types, sizes and special constructions to handle virtually "any substance that will flow through a pipe" including: syrups, acids, sludges, slurries, asphalt, bunker fuel, etc. There are deep and shallow well Centrifugal and Turbine types, Rotating Plunger and Herringbone Gear Pumps.

for VACUUM PROCESSING

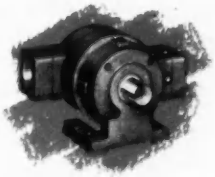
High vacuum pumps for laboratory, electronic, atomic research, biological and other chemical processing, vacuum refining of metals, de-aerating, dehydration, vacuum drying, refrigeration, etc.

HYDRECO GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.

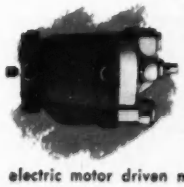
DUDCO DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in multiple units operating from a single drive. Hydraulic motors with starting torque outputs to 14,000 lb. in. at 2000 psi.



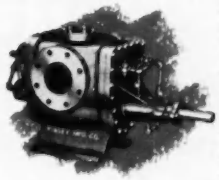
STRATOPOWER PISTON TYPE PUMPS

Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rmp with maximum of 4500 rmp . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.



KINNEY LIQUID HANDLING PUMPS

A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids, sludges, slurries or viscous substances. Available in plain or steam jacketed models and built of special corrosion resistant metals where desired.

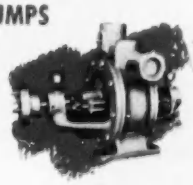


KINNEY VACUUM PUMPS

Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.

AURORA CENTRIFUGAL & TURBINE PUMPS

Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.



THE NEW YORK AIR BRAKE COMPANY

230 PARK AVENUE • NEW YORK 17, N. Y.

Write—

For detailed information on the type of pump in which you are interested.

THE NEW YORK AIR BRAKE COMPANY
230 Park Avenue., Dept. SAE, New York 17, N. Y.

Gentlemen: Kindly send additional information on the pumps I have checked.

- ☐ Hydreco Pumps
- ☐ Kinney Liquid Handling Pumps
- ☐ Stratopower Pumps
- ☐ Kinney Vacuum Pumps
- ☐ Dudco Pumps
- ☐ Aurora Pumps

Name .....

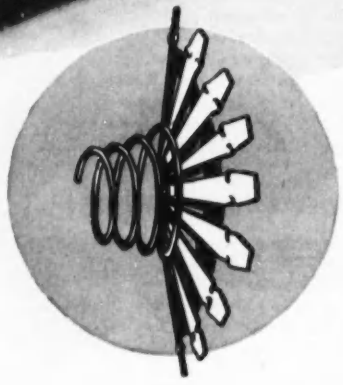
Address .....

City ..... State .....

The SOFT Acting Clutch with the SURE GRIP!

... Just Like a Hand of Steel in a Velvet Glove

LIPE MULTI-LEVER CLUTCH



The hand of steel in the Lipe Clutch has 20 fingers that equalize the pressure of a single spring—assuring softer engagement and a positive grip.

Lipe's soft engagement, positive grip Multi-Lever Clutch never needs babying. It engages smoothly—without grab, shock or jerk. All parts of the pressure plate touch at the same instant with the same pressure. No cocking—no point of high slippage and spot burning.

Result: More mileage between tear-downs.

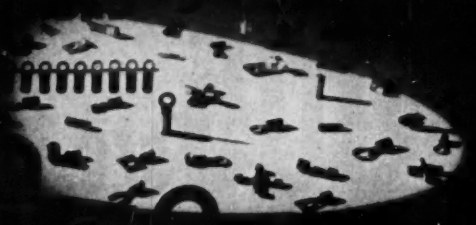
Write for Service Manual and complete data on genuine Lipe parts—stocked in principal cities.

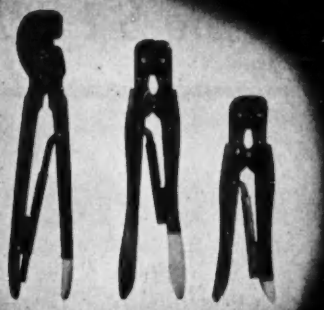
LIPE ROLLWAY

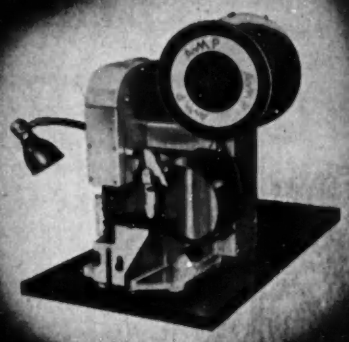
Lipe-ROLLWAY CORPORATION

Manufacturers of Automotive Clutches and Machine Tools

Syracuse 1, N. Y.





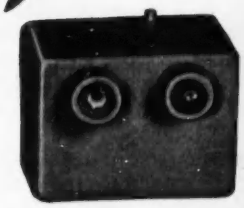


it's the Extra Factor of Assurance that counts...

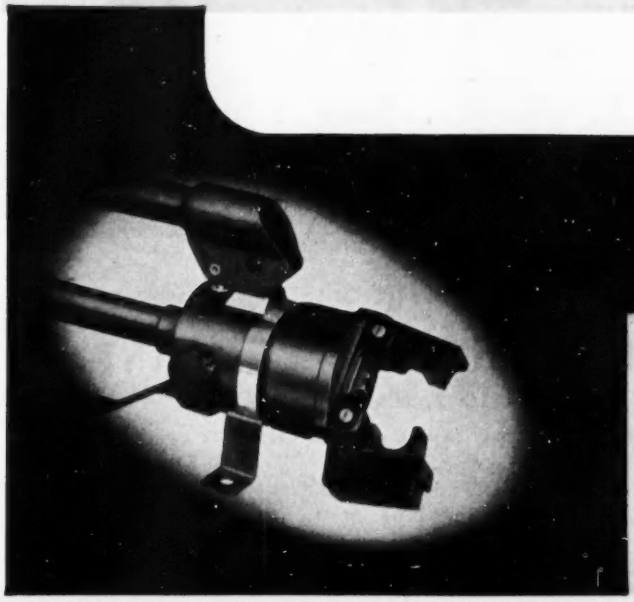
All the gadgets or combination tools in the world will not insure the correct installation of your wire terminations day in, day out, on the line. It's the extra factor of assurance that counts! AMP tools and terminals are made to use together. They're made so that you can be *sure* that you have a correctly installed termination. AMP application tools and dies and automatic machines are so designed that at the point of application you can control accuracy and uniformity within ±.003". Remember: In wire termination there is no short cut to precision and foolproof production!

Shown below: AMP CERTI-CRIMP* hand tools—will not release until proper crimping pressure has been reached. (Below right) the AMP INSPECTO-MASTER* gives continuous inspection at point of terminal application. Write to AMP for information about these and other recent developments in wire termination.

A-MP CONTROLLED WIRE TERMINATION



YOU CAN COUNT ON AMP



AMP

AIRCRAFT-MARINE PRODUCTS, INC.
2100 Paxton Street, Harrisburg, Pa.

Canadian representative:
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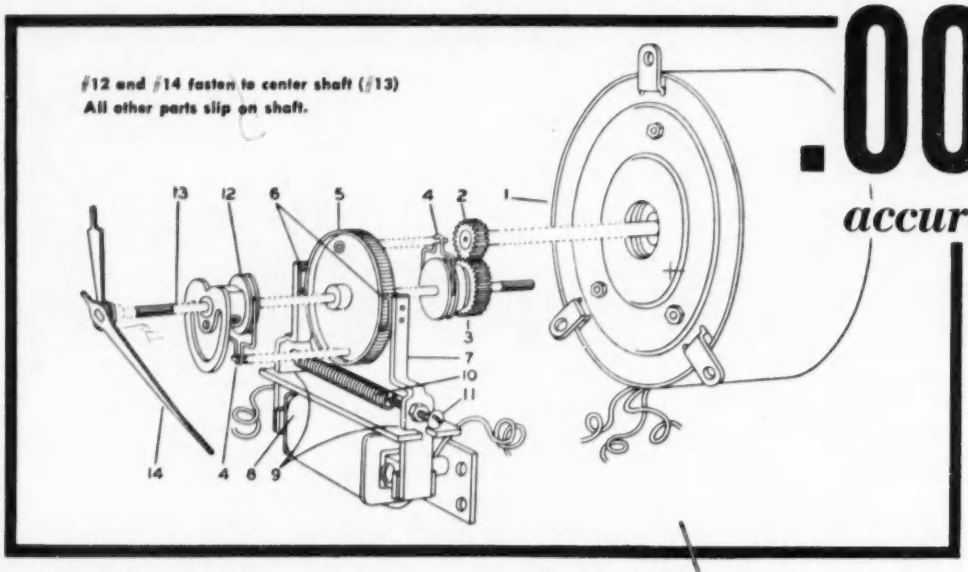
*Trade-Mark

Facts behind the S-1 TIMER'S extraordinary



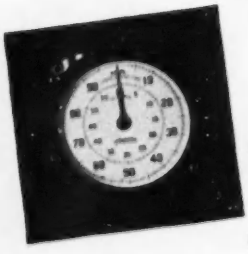
.005 SEC.
accuracy...

Formula S-1: **Expensive high torque, ball bearing motor, low inertia of moving parts, high proportion of precision and ground parts, no thrust bearings as found in ordinary clutches.**

- High torque (2 inch-ounce at 100 RPM) industrial grade motor (#1) with no internal gear train so small changes in load due to binds or hand acceleration cause no phase shift between rotor and rotating field . . . runs continuously to eliminate starting error.
- Precision cut gears (#2, #3). Any eccentricity or inaccuracies in gearing reflect directly in timer reading.
- Slip clutch composed of hardened steel spring (#4) riding a V-grooved graphited (for long wear) collet, applies .6 inch-ounces of torque to aluminum (for low inertia) control disc (#5) with over 314 tiny teeth in its periphery.
- To hold control disc (#5) at rest, 2 hardened steel brake shoes (#6), ground to square knife edges, grip periphery of control disc in 4 places . . . control disc position to under ½ of a degree (1/720 second).
- Electro magnet (#8) pulls brake shoes away from control disc through armatures (#7). Air gaps kept to minimum for speed. Precision made fulcrums prevent stickiness or unequal movement of armatures.
- Adjusting screw (#11) adjusts tension of armature spring (#10) so that time between energizing magnet coil and starting of control disc is same as time between de-energizing magnet coil and stopping of control disc. This compensates for starting and stopping errors.
- Second friction clutch (#2) transfers control disc motion to center staff (#13); allows hands to be reset when control disc is held stationary.

To Split the Split Second with ACCURACY, Take a Minute Now and Write Us for Engineering Data

"Gentlemen . . . Let me give you the formula for our astounding final accuracy of .005 sec. obtained with our D-C clutch S-1 Timer."



SINCE 1884 STANDARD

The STANDARD ELECTRIC TIME COMPANY

87 LOGAN STREET · SPRINGFIELD 2, MASSACHUSETTS

PRECISION TIMERS • CHRONO-TACHOMETERS • LABORATORY PANELS • PIPELINE NETWORK ANALYZERS

3 good reasons to GO with— GLOBE-UNION custom-built batteries

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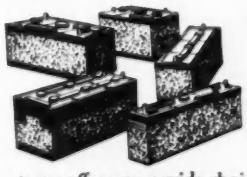
Globe *creative engineering* assures quality construction and unsurpassed design. Globe-built batteries continually set new, high standards of performance.

2 FAST, ECONOMICAL DELIVERY AND SERVICE

Get low freight costs and quick service. 13 Globe factories, strategically placed near your markets are located at ATLANTA, GA. • BOSTON, MASS. • CINCINNATI, OHIO • DALLAS, TEXAS • EMPORIA, KAN. • HASTINGS-ON-HUDSON, N. Y. • LOS ANGELES, CALIF. • MEMPHIS, TENN. • MINERAL RIDGE, OHIO • OREGON CITY, ORE. • PHILADELPHIA, PA. • REIDSVILLE, N. C.



3 THERE'S A GLOBE-BUILT BATTERY TO MEET YOUR NEEDS

Whatever your battery requirements — basic Globe sizes and types offer you a wide choice to meet any application. In addition, special models are made to meet special needs.

GLOBE-UNION

Globe batteries are custom-built for mass distribution under the trade name Globe Spinning Power and a host of leading private brands

GLOBE-UNION INC.

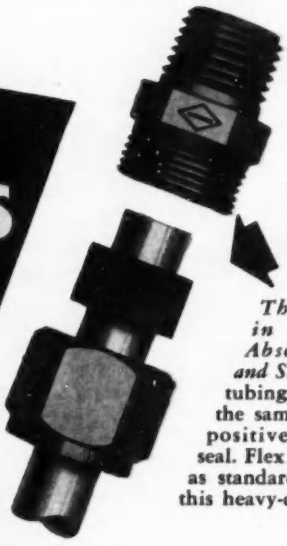
Milwaukee 1, Wisconsin

If it's petroleum powered, there is a Globe-built battery — right, from the start.

Got a tough tubing connection job?...

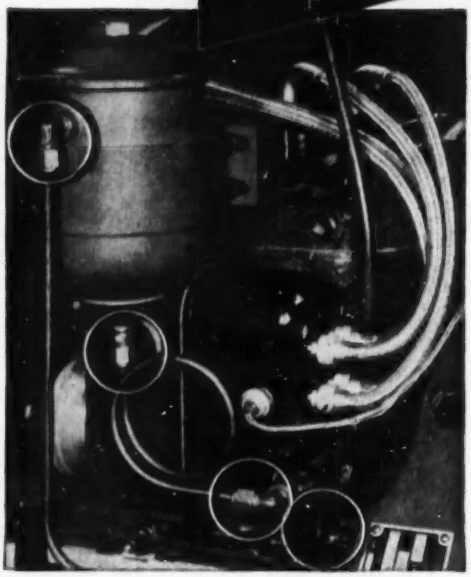
IMPERIAL FLEX FITTINGS

May Be the Answer

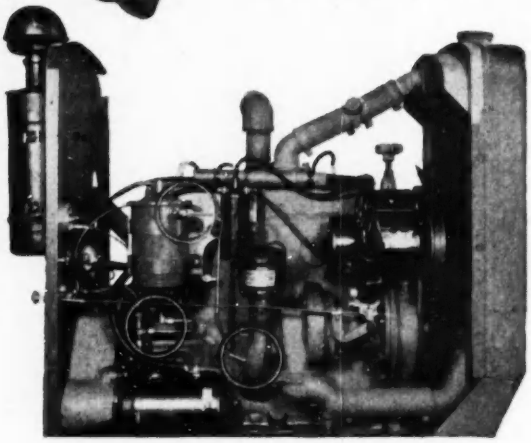


The tube coupling with vibration and shock absorbing sleeve.

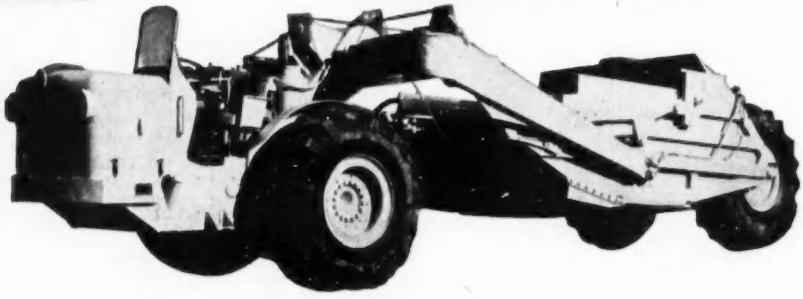
This Elastic Sleeve in Flex Fittings Absorbs Vibration and Shock . . . permits tubing to flex and at the same time assures a positive pressure tight seal. Flex Fittings are used as standard equipment on this heavy-duty engine.



Flex Fittings make joints virtually indestructible by VIBRATION . . . withstand SHOCK and MINOR TUBE MOVEMENT



Flex Fittings, circled on this engine, are very easy to install . . . simply slip nut and Flex sleeve over tubing . . . insert tubing into body as far as it will go and tighten nut—that's all.



Whether it's earth movers (illustrated), tractors, diesel engines, heavy power equipment or machinery, Flex Fittings will do the job. They have been thoroughly proved by extensive use.

Flex Fittings Can Be Used With All Kinds of Tubing

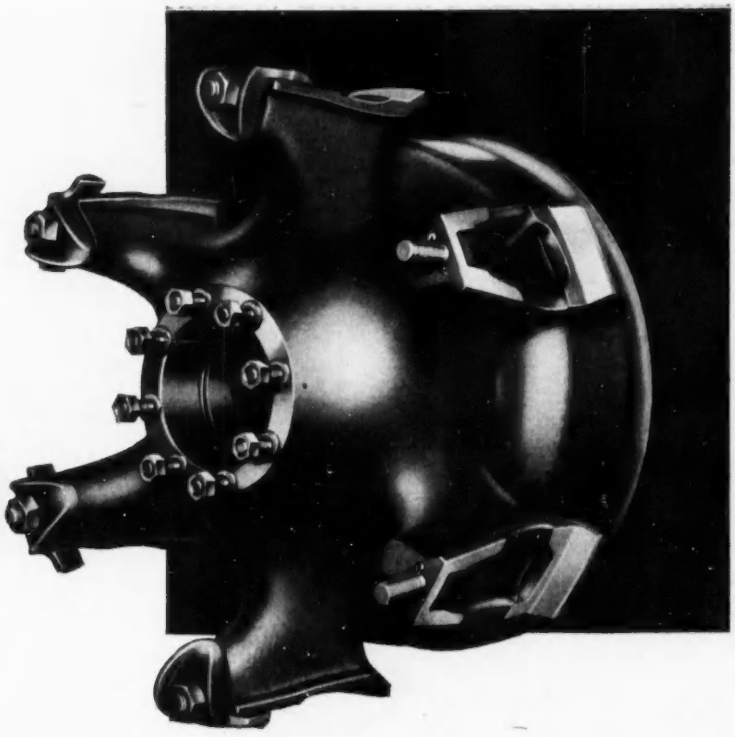
Imperial Catalog 344 gives you complete information on Flex Fittings. Ask for your copy.

THE IMPERIAL BRASS MFG. CO., 1225 W. Harrison St., Chicago 7, Illinois

IMPERIAL

PIONEERS IN TUBE FITTINGS AND TUBE WORKING TOOLS

GUNITE WHEELS



Take Bigger Loads Over Rougher Roads

● . . . save vital pounds, too!

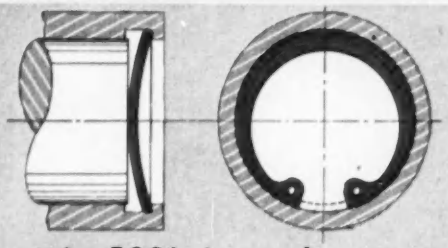
There are two important reasons why Gunite truck and trailer wheels provide dependable heavy-duty service . . . while assuring minimum unsprung weight. One is the *metal* . . . precisely controlled castings are used to make Gunite wheels strong and rigid . . . ready to withstand the toughest road abuse. The other is Gunite's *tubular spoke design* . . . which creates maximum strength through accurate weight distribution • Gunite tubular-spoke wheels are rugged . . . yet, save vital pounds . . . cut per mile operating costs. Six low-torque floating rim bolts eliminate servicing headaches. Specify Gunite lightweight cast-steel wheels for your rigs.

They'll save you money at no premium in price.

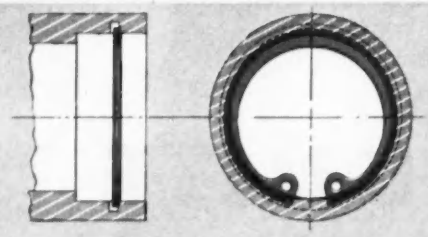
GUNITE

GUNITE FOUNDRIES CORPORATION, Rockford, Illinois

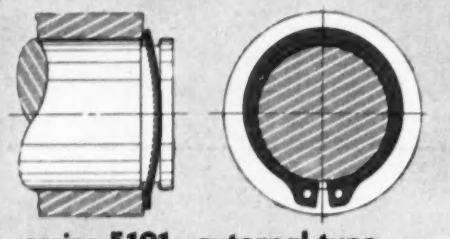
if end-play take-up is a problem
one of these special Waldes Truarc rings can solve it



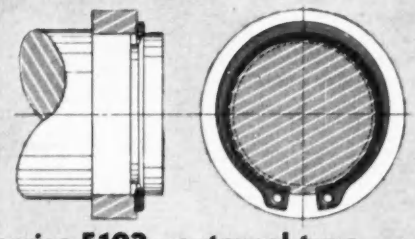
series 5001 · internal type
for bore diameters from: .250 – 1.456 in.



series 5002 · internal type
for bore diameters from: 1 – 10 in.



series 5101 · external type
for shaft diameters from: .188 – 1.438 in.



series 5102 · external type
for shaft diameters from: 1 – 10 in.

bowed WALDES TRUARC RETAINING RINGS

Take up end-play resiliently, damp vibrations and oscillations. Bent like a bow out of plane at horizontal center line. The bowed Truarc ring acts in axial direction like a floating spring without losing its tight grip against the bottom of the groove.

Maximum resilient end-play take-up: .015" to .020" depending on size of ring.

beveled WALDES TRUARC RETAINING RINGS

Take up end-play rigidly. When the ring is contracted (or expanded), the tapered edge acts like a wedge moving deeper into the groove and shifting in an axial direction until the ring abuts the machine part.

Maximum end-play take-up, depending on ring size: internal types, .005" to .043"; external types, .005" to .040".

WALDES TRUARC is much more than a better way to hold parts together

Thousands of manufacturers have already found that Truarc Retaining Rings cut production costs and speed assembly by simplifying product design. But that's not all.

Waldes Truarc engineers have extended the use of retaining rings by developing rings that perform *additional functions* while acting as retaining shoulders. Those shown here take up end-play, compensate for wear and varying manufacturing tolerances.

No matter what *your* problem, there's a Waldes Truarc Ring designed specifically to solve it. Send us your drawings, your questions—Waldes Truarc engineers will work with you, at no obligation.

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TRUARC
REG. U. S. PAT. OFF.
RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,383,947; 2,383,948; 2,410,055; 2,420,921; 2,420,341; 2,420,705; 2,441,840; 2,455,165; 2,455,390; 2,455,393; 2,487,905; 2,487,909; 2,491,306; 2,509,001 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog. SA 045

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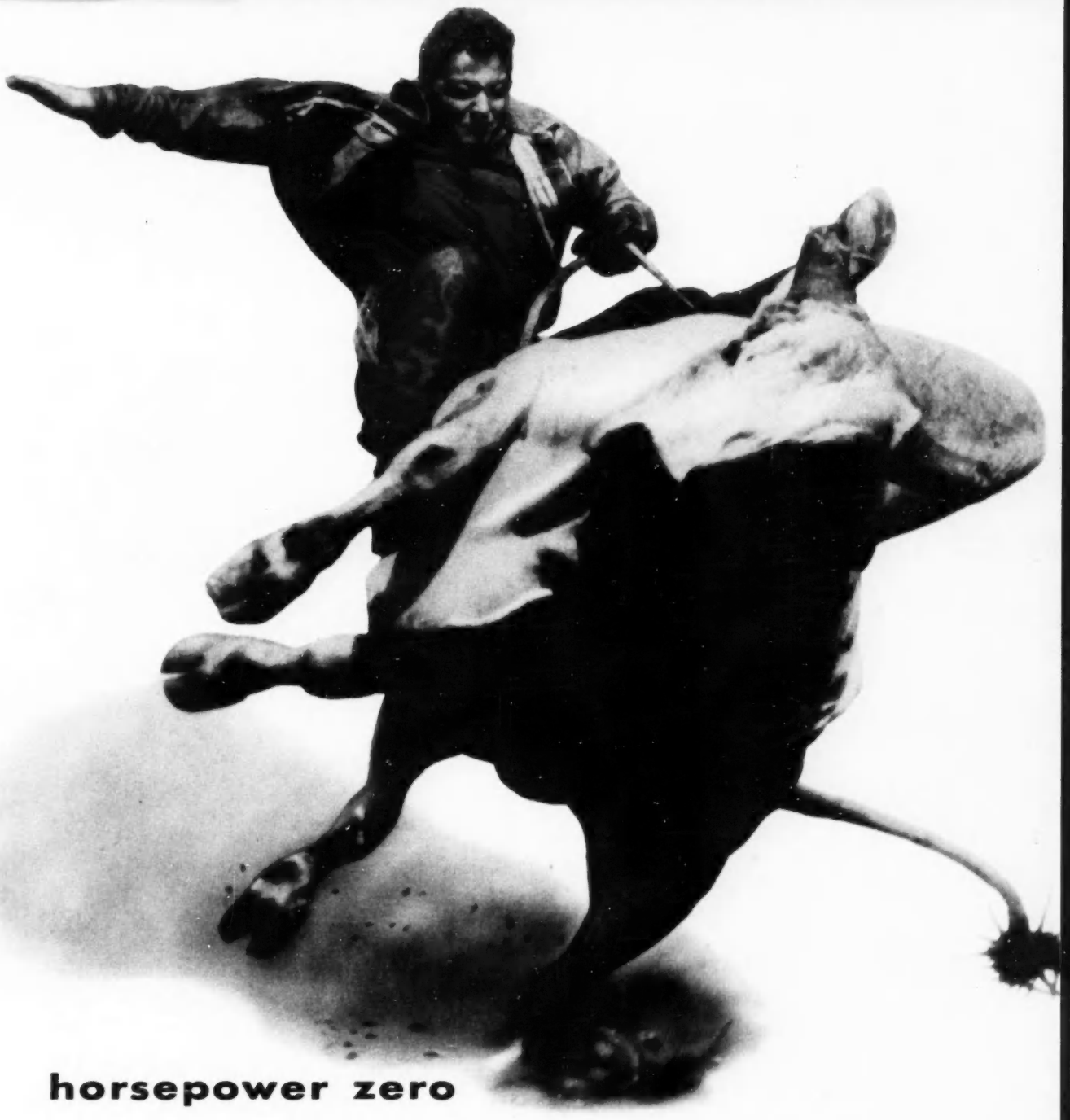


horsepower zero

This is the acme of hooking, buckling, useless horsepower. In many smaller ways, it is typical of power wastes that may leak out between motor and traction surface in automotive vehicles.

Spicer has nearly 50 years' experience in helping manufacturers secure maximum efficiency from generated horsepower.

Designing, Developing, Engineering, Manufacturing and Service

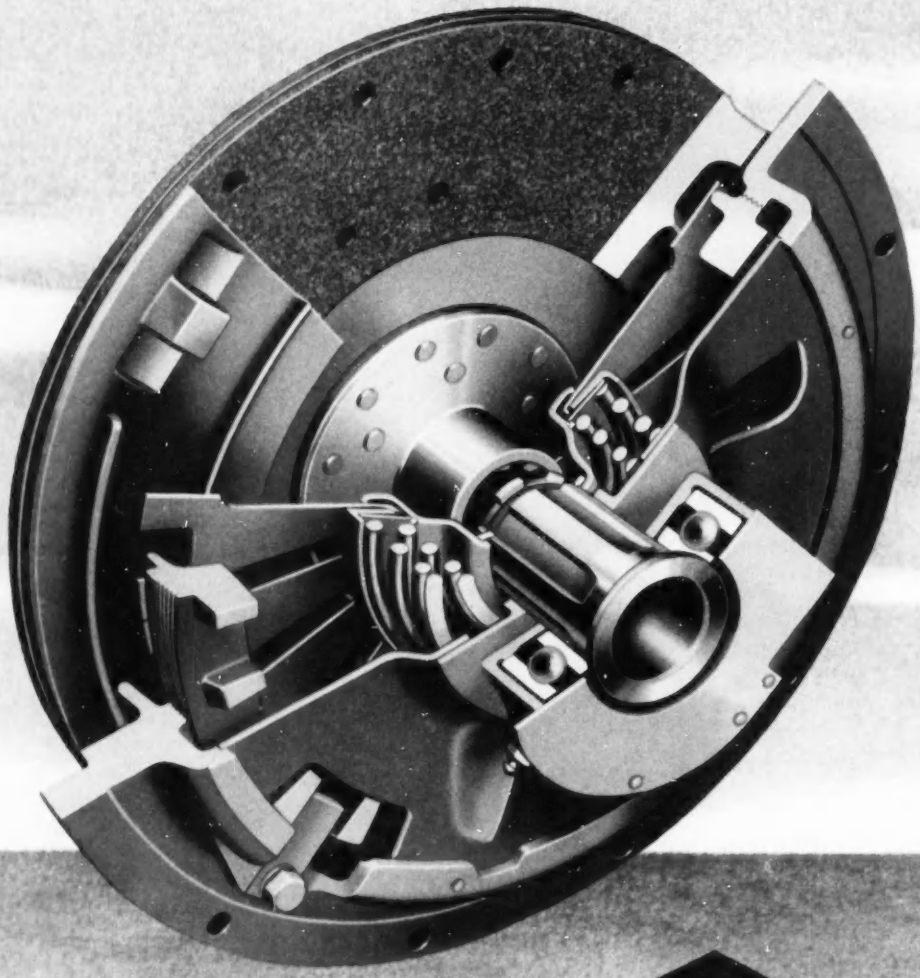
Spicer

smooth sailing

The zephyr touch . . . the effortless engaging . . . the cloud-floating action of the Spicer Brown-Lipe Clutch are well-known to the heavy-duty truck and bus operators. They readily accept the small initial higher cost in exchange for the exceptional performance . . . and long life . . . assured by the many exclusive features in this Spicer unit. It is the

Standard of the Industry

SPICER MANUFACTURING DIVISION *of Dana Corporation* • **TOLEDO 1, OHIO**



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TRANSMISSIONS • UNIVERSAL JOINTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • PASSENGER CAR AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES

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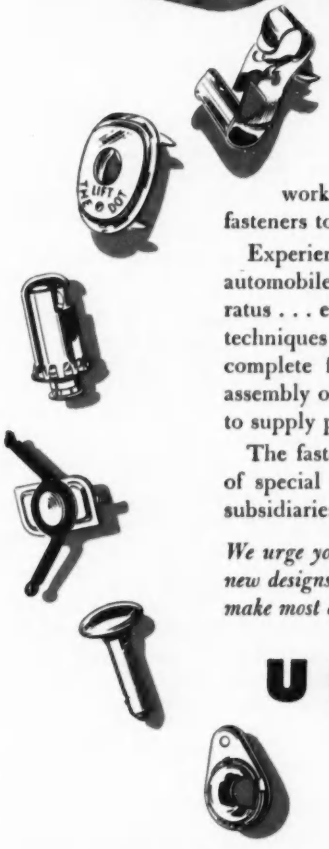
Get DOT® to do it!



Turn your special fastening problems over to United-Carr and free your own design staff for full-time work on finished-product engineering.

United-Carr's engineering department is constantly at work, improving current DOT fasteners and designing entirely new fasteners to meet the changing needs of industry.

Experience gained through working with the leading manufacturers of automobiles, aircraft, appliances and furniture as well as electronic apparatus . . . enables us to bring an unusually wide variety of abilities and techniques to bear on your particular fastening problems. And, with complete facilities for volume production of metal fasteners and the assembly of metal to plastic and ceramic components, we are in a position to supply practically any fastening need.

The fasteners and assemblies illustrated here are typical of thousands of special devices designed and manufactured by United-Carr and its subsidiaries.

We urge you to call in your nearest United-Carr field engineer before *your new designs crystallize. It is at this all-important planning stage that you can make most effective use of our special services.*

UNITED-CARR

MAKERS OF DOT FASTENERS

UNITED-CARR FASTENER CORPORATION, CAMBRIDGE 42, MASSACHUSETTS

NATIONAL OIL SEAL LOGBOOK

Write our Redwood City office for reprints of this page

Sealing News & Tips

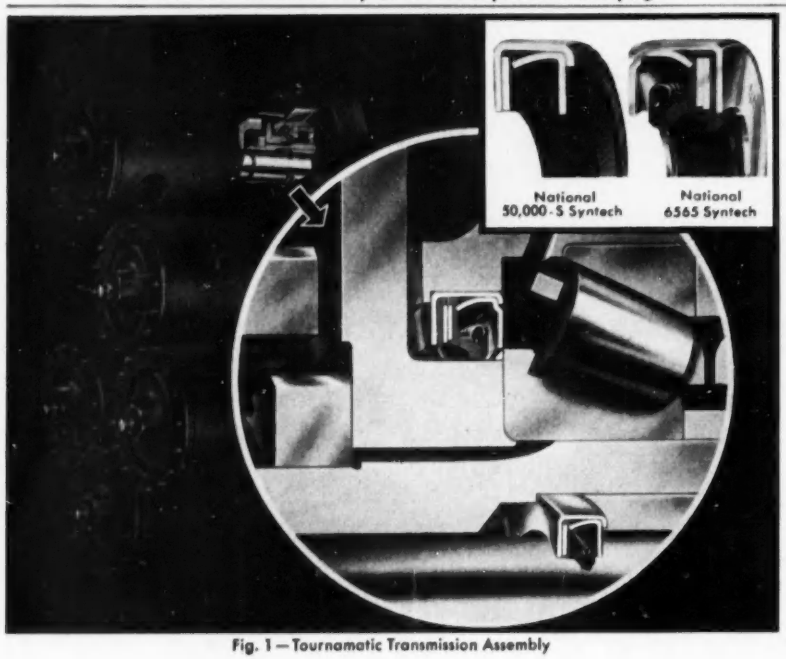


Fig. 1—Tournamatic Transmission Assembly

Concentrically-mounted National Oil Seals provide efficient sealing in Le Tourneau automatic clutch

The Le Tourneau Super C Tournadozer utilizes a constant-mesh, instant-shift transmission ruggedly designed with short, heavy shafts, helical-cut gears and anti-friction bearings. To protect gears and bearings and prevent lubricant leakage, ten National Oil Seals are installed in each transmission.

The transmission assembly (Figure 1) has five different shaft assemblies, and each utilizes two National seals mounted concentrically. The inner seal in each assembly is a standard-design National 50911-S Syntech* unit with a spring-tensioned synthetic rubber sealing member. It operates on an 870 r.p.m. (maximum) shaft hardened to 58-62 Rockwell and finished to ±0.0005. Its function is to protect the clutch from heavy gear oil.

At the outer position, Le Tourneau uses a special National 6565 Syntech seal with a conventional spring-loaded main sealing member to retain bearing grease and a springless external lip to exclude dirt and water. This seal has a steel O.D. which fits into the retainer.

In solving these sealing problems, Le Tourneau and National Applications Engineers worked together, utilizing both standard-design and special National seals. In many cases, standard-design National seals solve problems quickly and economically; other applications may demand modifications to meet special conditions. In either event, National can offer you on-the-spot engineering help backed by 30 years of experience in solving sealing problems. Call the nearest National Applications Engineer for consultation.

Fig. 2—Super C Tournadozer

*Trade Mark Registered

New National O-Rings

National, a world leader in oil seals, now offers a complete line of O-Rings. National pioneered O-Rings two decades ago through a subsidiary organization. With O-Rings an integral part of the National line, you will get better engineering and sales service, consistent quality and uniformity, and the convenience of a common source for oil seals, O-Rings and shims.

New O-Ring Catalog

Here's the most broadly useful compilation of O-Ring data published. It includes engineering, design and compound information, gland groove and back-up ring requirements, etc. Lists all National O-Rings. Request free copy on your letterhead, giving your title.

National Shims, Shim Seals

National Shims and Shim Seals are available in a broad range of sizes and shapes and in all thicknesses from .001" upward. The uniform density of metals employed prevents compressing under severe pressure. National Shims are used by all leading vehicle, equipment and machinery manufacturers. For complete information, request Catalog 93.

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OIL & GREASE SEALS
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NATIONAL MOTOR BEARING CO., INC.

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NEWARK, N. J. . *Suite 814, 1180 Raymond Blvd., MItchell 2-7586*
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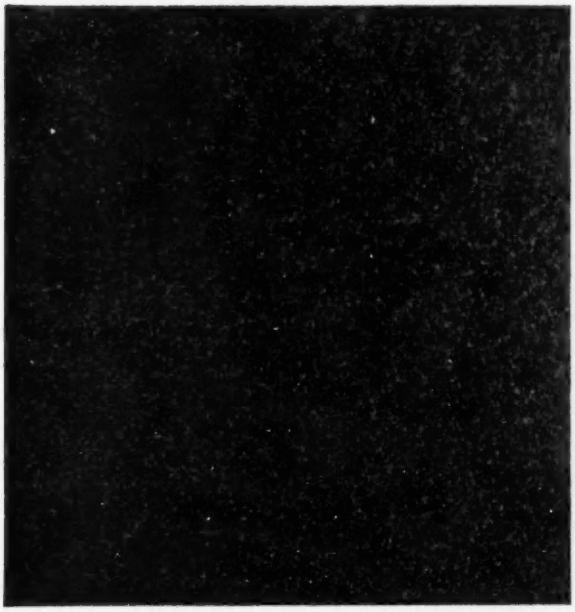
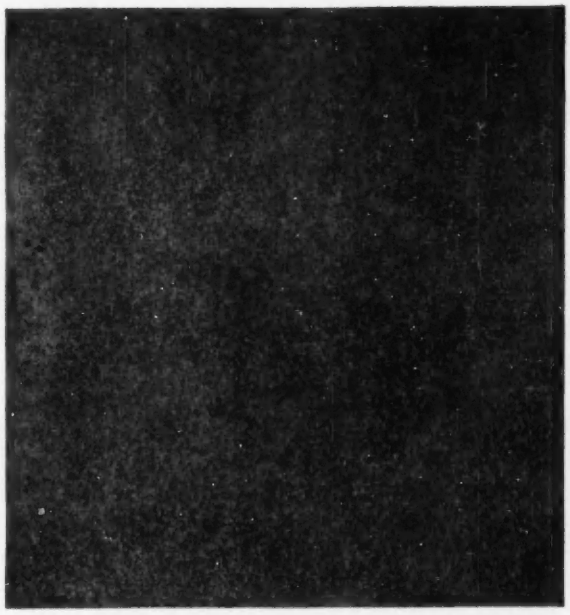


When plain carbon steel is exposed to the atmosphere, it begins to oxidize almost immediately and a layer of rust forms over the surface. After a brief period this rust has a tendency to curl up and flake off, leaving the metal exposed to further corrosive action.



Corrosion also takes place when Mayari R is exposed to the atmosphere. But the rust is different. Instead of flaking, it forms a thin, tight coating that holds securely to the surface and retards further corrosion of the metal beneath. And this in turn means longer life for Mayari R.

Why Mayari R Has Longer Life than Plain Carbon Steel

Tests conducted over a 10-year period show that Mayari R has 5 to 6 times as much resistance to atmospheric corrosion as plain carbon steel—and 2 to 4 times as much as copper-bearing steel.

During the first year of exposure under these tests, each of these three metals lost practically the same amount of weight through corrosion. But following that initial loss, the corrosion of the Mayari R gradually slowed down. After a few years it appeared to stop altogether. The plain carbon steel and the copper-bearing steel, on the other hand, continued to rust away and lose weight year after year, with practically no decrease in the rate of corrosion.

Mayari R has other advantages. It has better abrasion-resistance, higher yield point, and greater tensile strength than ordinary steel. These properties all contribute to improved design and longer life of equipment and structures.

You can get further information about Mayari R low-alloy, high-strength steel by writing to any of our sales offices for Catalog 259.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Mayari R *makes it lighter...stronger...longer lasting*

U·S·S CARILLOY Steel in rolled sections . . . . . .

LANDING FLAPS on the Model 340 Convair airliner slide on tracks made of CARILLOY 4140 steel T-sections. These tracks are much stronger than those formerly made from rectangular bars. And they cost 75% less!

lops 4 hours off machining time,

provides stronger flap tracks for Convair airliners

and cuts costs 75%

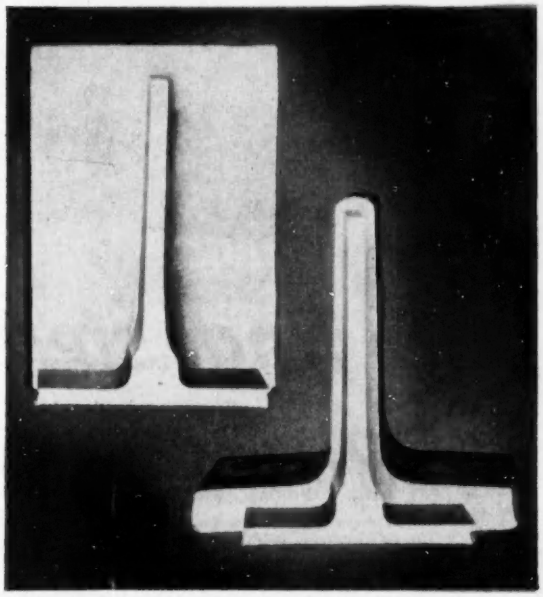
● Wing flap supports for Consolidated Vultee's Model 340 Convair airliners are stronger, cost *less*, and are of better quality now that they are made from hot-rolled sections of U·S·S CARILLOY steel.

When J. C. Peacock Co., of Los Angeles, California, started making these T-shaped flap tracks for Convair, the accepted practice was to machine them from 2¼" x 3¼" bars of alloy steel. But machining took a lot of time, and more than 50% of the stock metal was wasted in scrap.

Peacock and Convair engineers studied the problem and soon realized that they could shorten machining time and reduce scrap losses by fabricating directly from rolled sections. The question was, where to find a good supply of steel that would meet all the exacting quality requirements? Our Columbia-Geneva Division came through for them, by providing hot-rolled T-sections of CARILLOY 4140 steel.

This steel is giving excellent results. Not only are the CARILLOY parts *stronger* than those formerly used, but they require 4 hours less machining time, and reduce scrap losses 60%. What's more, finished tracks now cost only *one-fourth* as much as they did before.

Our experienced steel engineers and metallurgists may be able to help you make similar savings on *your* products. Call our nearest District Office. Chances are we can supply just the steel and the form you need.



LEFT, the T-shaped cross-section of a flap track in front of a 2¼" x 3¼" steel bar shows how much metal was formerly wasted.

RIGHT, the same flap track in front of the CARILLOY T-section that cuts scrap loss 60%.

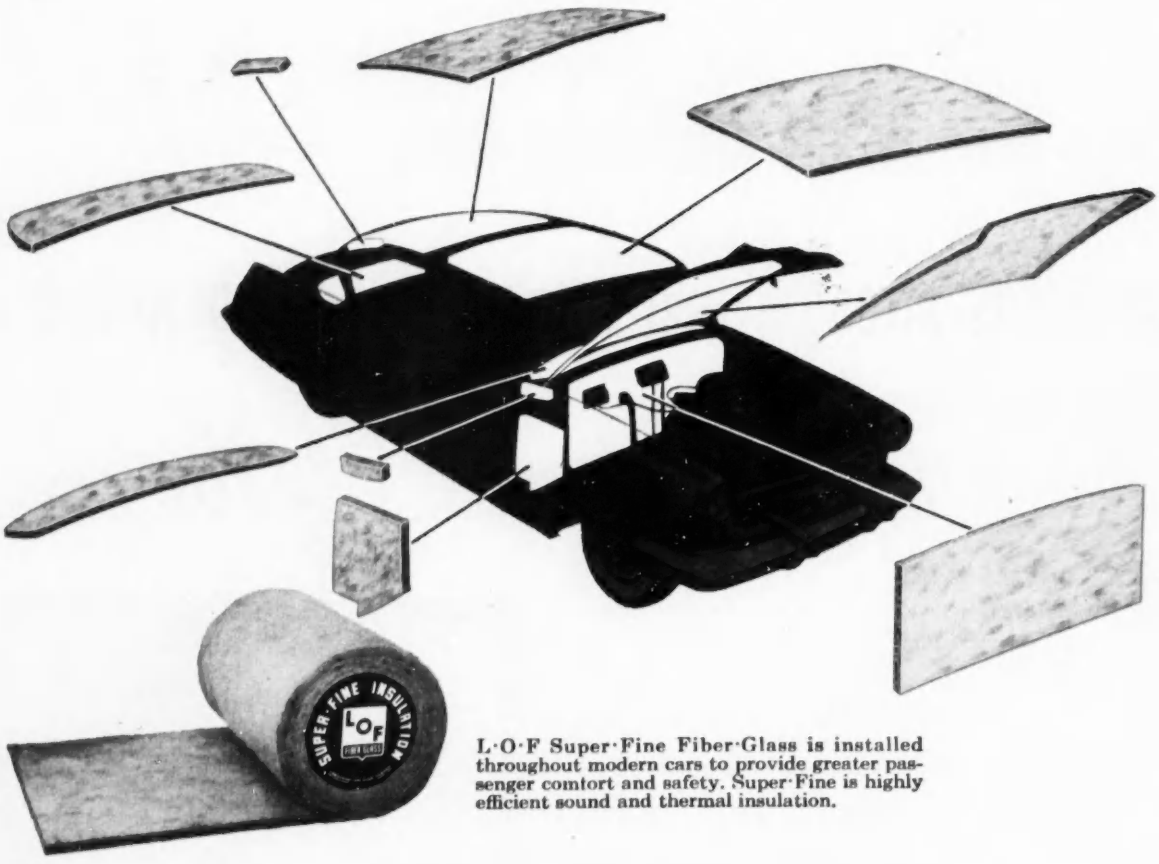
UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Carilloy USS Steels

ELECTRIC FURNACE OR OPEN HEARTH · COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

3-843

UNITED STATES STEEL



L·O·F Super·Fine Fiber·Glass is installed throughout modern cars to provide greater passenger comfort and safety. Super·Fine is highly efficient sound and thermal insulation.

Your final step in muting high-frequency engine noise!

The successful effort to quiet an engine begins with attention to moving parts, and ends with a blanket of L·O·F Super·Fine Fiber·Glass installed under the hood and on the fire wall. There are few owner satisfactions to compare with an engine that never speaks above a whisper.

Inherently suited to those applications, L·O·F Super·Fine muffles high-frequency engine noise, tire whine, airstream whistle, helps block heat passage into car body. The glass fibers resist fire, oil, grease and most acids.

Other applications of L·O·F Super·Fine Fiber·Glass —liners in roof, under package trays, on dashboard— further support your continuing effort to offer customers engines that speak only in whispers and auto bodies that offer increased passenger comfort.

On your production lines, featherweight L·O·F Super·Fine is easily handled, quickly applied without lost motion. Of course, it almost goes without saying that you can depend on Libbey·Owens·Ford, with its long automotive experience, to deliver top-quality Super·Fine Fiber·Glass right on schedule.

For further information, call L·O·F's Detroit office, 610 Fisher Building, TRinity 5-0080. Or write us for the names of Hoodliner-Kit suppliers. Libbey·Owens·Ford, Dept. FG 643, Wayne Building, Toledo 3, Ohio.

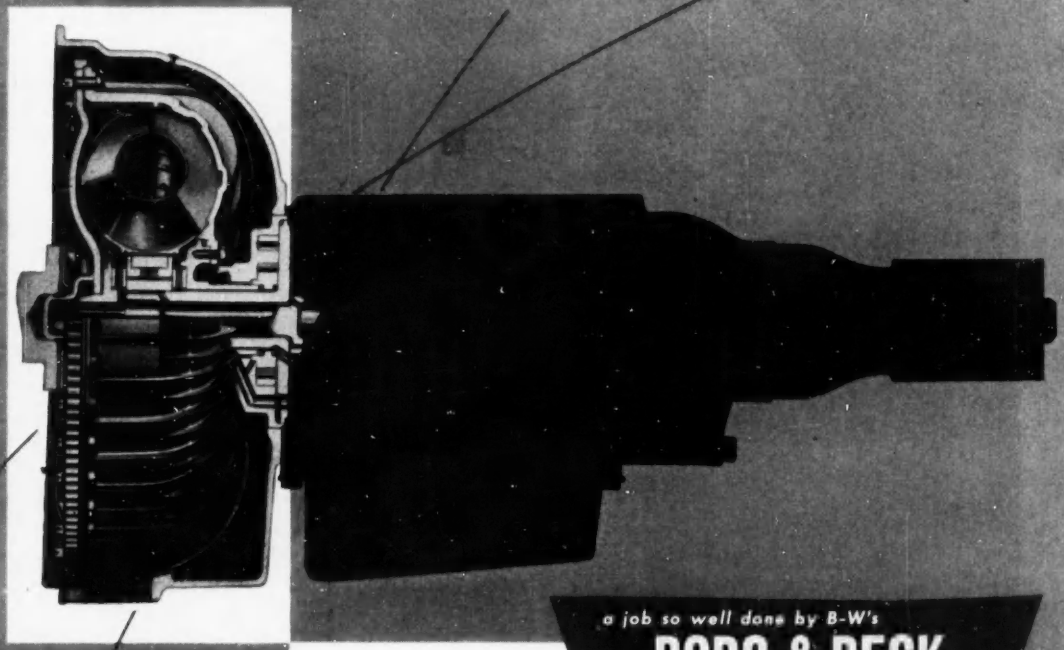
LOF GLASS PLASKON FIBER·GLASS

LIBBEY·OWENS·FORD GLASS COMPANY

FIBER·GLASS DIVISION

FIBER·GLASS

helping to put the AUTOMATIC in automatic transmissions



a job so well done by B-W's

BORG & BECK *division*

Borg-Warner's Borg & Beck clutches for standard automotive transmissions are known and used the world over. With the swing to automatic transmissions, Borg & Beck was ready again with the perfected Borg & Beck torque converter for that vital spot where power takes hold of the load.

On leading makes of cars with automatic transmissions, power is transferred by this new, unique, simplified converter. Exceptionally light in weight, air cooled, with a torque ratio of 2.1 to 1, it is highly efficient, remarkably dependable in helping to put the "automatic" in automatic transmissions.

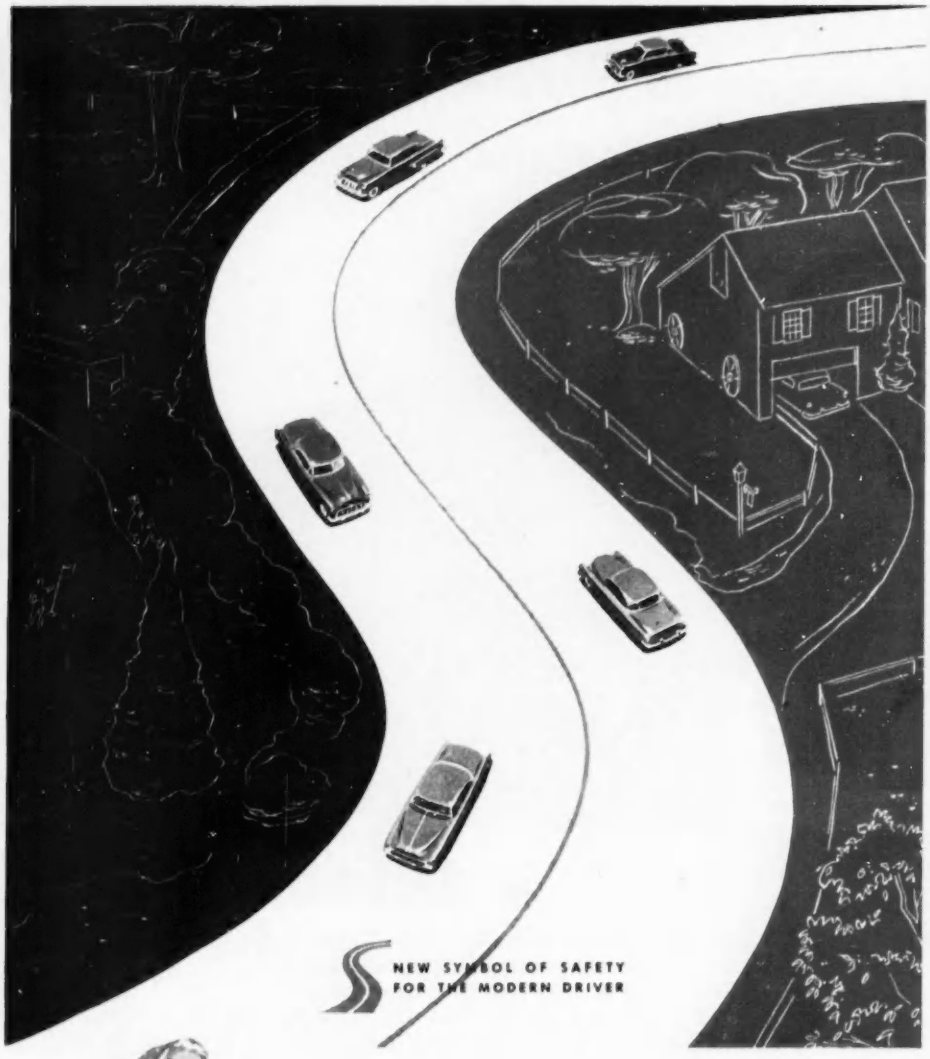
This is one more outstanding example of how "Borg-Warner engineering makes it work—Borg-Warner production makes it available." It is a typical example of how Borg-Warner serves the automotive industry—and the American public—every day.

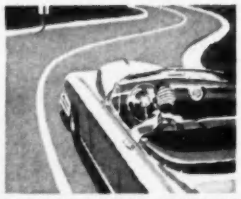
ALMOST EVERY AMERICAN BENEFITS EVERY DAY FROM THE 185 PRODUCTS MADE BY BORG-WARNER

ENGINEERING B-W PRODUCTION

B-W engineering makes it work
B-W production makes it available

THESE UNITS FORM BORG-WARNER, Executive Offices, Chicago:
ATKINS SAW • BORG & BECK • BORG-WARNER INTERNATIONAL
BORG-WARNER SERVICE PARTS • CALUMET STEEL • CLEVELAND COMMUTATOR
DETROIT GEAR • FRANKLIN STEEL • INGERSOLL PRODUCTS • INGERSOLL STEEL
LONG MANUFACTURING • LONG MANUFACTURING CO., LTD. • MARBON
MARVEL-SCHEBLER PRODUCTS • MECHANICS UNIVERSAL JOINT • MORSE CHAIN
MORSE CHAIN CO., LTD. • NORGE • NORGE HEAT • PESCO PRODUCTS • REFLECTAL
ROCKFORD CLUTCH • SPRING DIVISION • WARNER AUTOMOTIVE PARTS
WARNER GEAR • WARNER GEAR CO., LTD. • WOOSTER DIVISION





SAGINAW POWER STEERING *lets you keep the real "feel of the road"*—leaves the driver in full command while it lends a helping hand.

SAGINAW POWER STEERING makes parking a breeze! You can maneuver with fingertip ease. No more wrestling with the wheel.

SAGINAW POWER STEERING cushions the "shake" and shock of rutty road surfaces—takes strain and fatigue out of country driving.

SAGINAW POWER STEERING lets you drive *relaxed* all day—arrive refreshed. No more strain from tense steering wheel grip.

Feather-Touch Steering that features Safety-First!

There's a new trend in modern driving! A trend to *Saginaw Power Steering*, hailed as the greatest automotive advance of the past 10 years. *Saginaw Power Steering* is already making driving easier and safer for more than a quarter million drivers. *Saginaw Power Steering* lets you keep *"the feel of the road"* while it does the hard work for you. *Saginaw Power Steering* is one of many products developed and produced by *Saginaw Steering Gear Division*, General Motors Corporation, Saginaw, Michigan—world's largest producer of steering gears.

Saginaw

POWER STEERING

AXLES

Why specify "WARMED-OVER" AXLES designed prior to World War II?

TDA builds the only "family" of advanced-related design front and rear axles and six-wheel units in a complete range of capacities for motor trucks and buses. Also trailer axles and brakes.

THE TIMKEN-DETROIT AXLE COMPANY • Detroit 32, Michigan

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

PLANTS AT: Detroit and Jackson, Mich. • Oshkosh, Wis. • Utica, N.Y. • Ashtabula, Kenton and Newark, Ohio • New Castle, Pa.

Hypoid Gearing

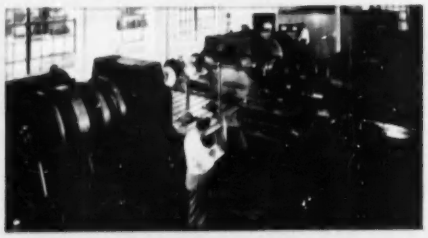
CUTS TRUCK MAINTENANCE COSTS —ADDS EXTRA MILEAGE

Years were spent in developing, testing and proving Hypoid for use in heavy-duty trucks

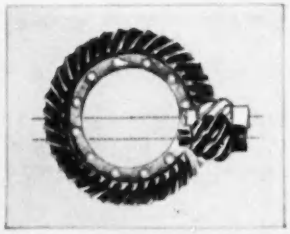
Truckers today are getting more miles per truck, under tougher operating conditions, than ever before. Such major improvements as Hypoid gearing, developed and built by TDA, are increasing truck life and reducing maintenance in spite of the heavy schedules of a defense economy.

Used on many makes of automobiles for more than a decade, Hypoid gearing is strictly a postwar development in medium- and heavy-duty truck axles. TDA, realizing its inherent advantages, spent years developing and testing before the first Hypoid-geared truck axles were placed in mass production. Today, only TDA offers Hypoid gearing in all three types of final drives—single-reduction, double-reduction and two-speed double-reduction—in a complete range of capacities.

Although a relatively new development, Hypoid truck axle gearing has been fully tried and proved. Billions of ton-miles have been rolled up in actual on-the-job operation since it was first introduced to truckers by TDA a few years ago. Find out why you should insist on rugged, dependable Hypoid gearing in the next medium- and heavy-duty trucks you buy. Write to TDA for an informative, illustrated booklet on Hypoid gearing.



A COMPLETE "INDOOR PROVING GROUND" makes it possible for TDA engineers to test heavy-duty truck axles under the same conditions as those that are actually encountered on the toughest stretches of America's highways. Truck axle torques and speeds can be reproduced, and repeated accurately, time after time. Advanced engineering facilities like this enable TDA to design and build the finest truck and bus axles in the world.



HYPOID PINION IS OFFSET FROM THE CENTERLINE OF THE GEAR. As a result the pinion is bigger and stronger. Bearings are bigger. More teeth are in contact, reducing loading per unit of contact area. Torque transmitting capacity is increased. Slower gear ratios are practical without loss of strength.

The Accepted TDA Standard

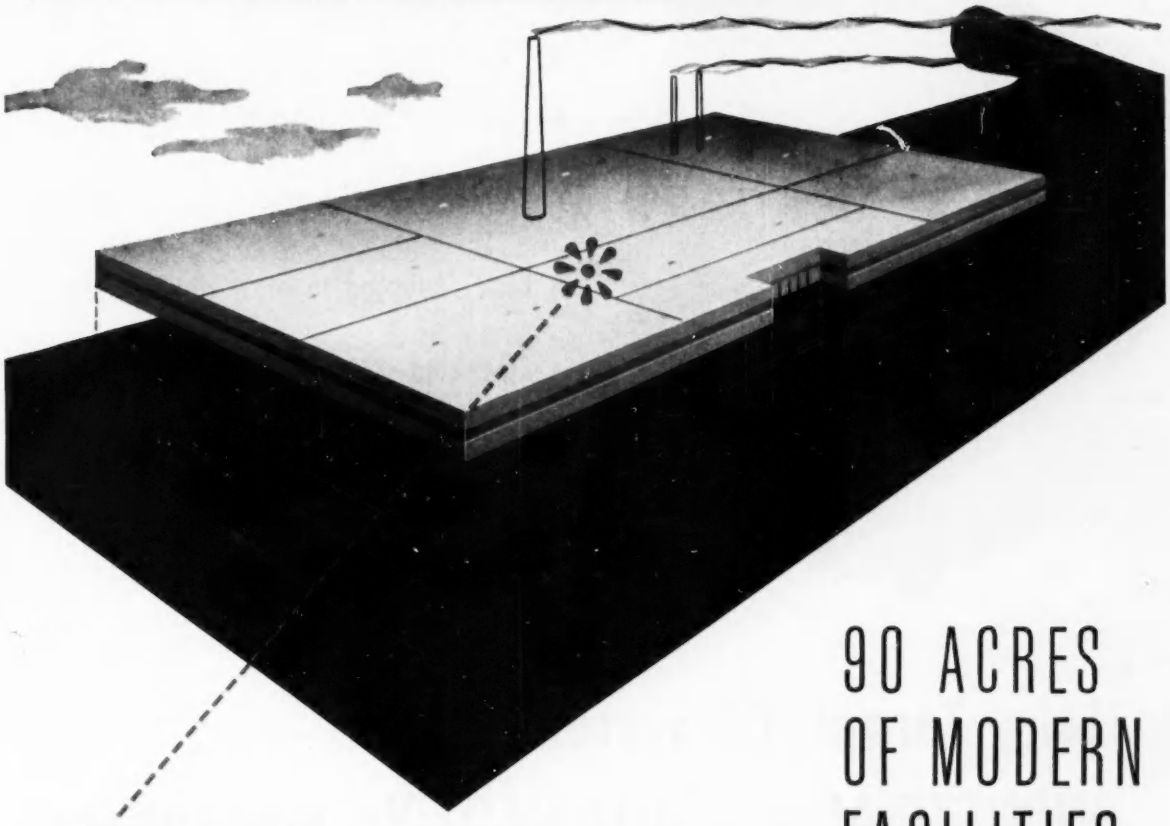
AXLES

THE TIMKEN-DETROIT AXLE COMPANY
Detroit 32, Michigan

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

PLANTS AT: DETROIT AND JACKSON, MICH. • OSHKOSH, WIS. • UTICA, N. Y. • ASHTABULA, KENTON AND NEWARK, OHIO • NEW CASTLE, PA.

FUNDAMENTAL FACTORS IN EQUIPMENT LEADERSHIP



90 ACRES OF MODERN FACILITIES

JUST as a modern scientific farm divides its acreage between experimentation and production — so, too, are AC's 90 acres of floor space systematically arranged.

There is a large section in AC that is devoted to planning, designing and testing of new products — as well as the specialized machines that will produce them.

The balance of AC's huge plant area is manned and equipped for the express purpose of manufacturing the fine automotive equipment that AC's 300 customers and *their* customers can rely on every day.

If you are interested in AC's extensive facilities for designing and producing *your* equipment needs, your inquiry will be welcomed at any of the offices below:

AC QUALITY PRODUCTS

• ADAPTERS (Drive) • AIR CLEANERS • AIR CLEANERS AND SILENCERS (Combination) • AMMETERS • BREATHERS (Crankcase) • CAPS (Radiator Pressure) • FLEXIBLE SHAFT ASSEMBLIES • FUEL PUMPS • FUEL AND VACUUM PUMPS (Combination) • FUEL FILTERS & STRAINERS • GASOLINE STRAINERS • GAUGES—AIR (Pressure) • GAUGES—GASOLINE • GAUGES—OIL (Pressure) • GAUGES—TEMPERATURE (Water, Oil) • OIL FILTERS (Lube) • PANELS (Instrument) • SPARK PLUGS • SPEEDOMETERS • TACHOMETERS • TERMINALS (Ignition Wire) • VALVES (Crankcase Ventilation)

FLINT—1300 North Dort Hy.
CHICAGO—Lincoln Tower Bldg.
DETROIT—General Motors Bldg.

AC SPARK PLUG DIVISION GM GENERAL MOTORS CORPORATION

- Stampings, not castings
- Welded for strength
- Easily adapted to most power units
- Air-cooled—Oil cooler can be added
- Leak-proof construction
- Low-cost manufacturing

Long Torque Converter for INDUSTRIAL and AUTOMOTIVE applications

New design and manufacturing methods permit us to combine top performance and low cost in Long torque converters. Already in high-volume production for passenger car use, they can be readily modified to many industrial applications. Eleven and 12-inch diameters cover a range of engines from 90 to 200 pounds-feet torque, depending upon nature of service. With torque ratios at stall of 2.1 to 1 and efficiencies over 90%, they should simplify many power transmission problems. We are prepared to extend the engineering cooperation required to insure a satisfactory installation. Your inquiries are invited.

LONG MANUFACTURING DIVISION • BORG-WARNER CORP. • DETROIT, MICH. AND WINDSOR, ONT.

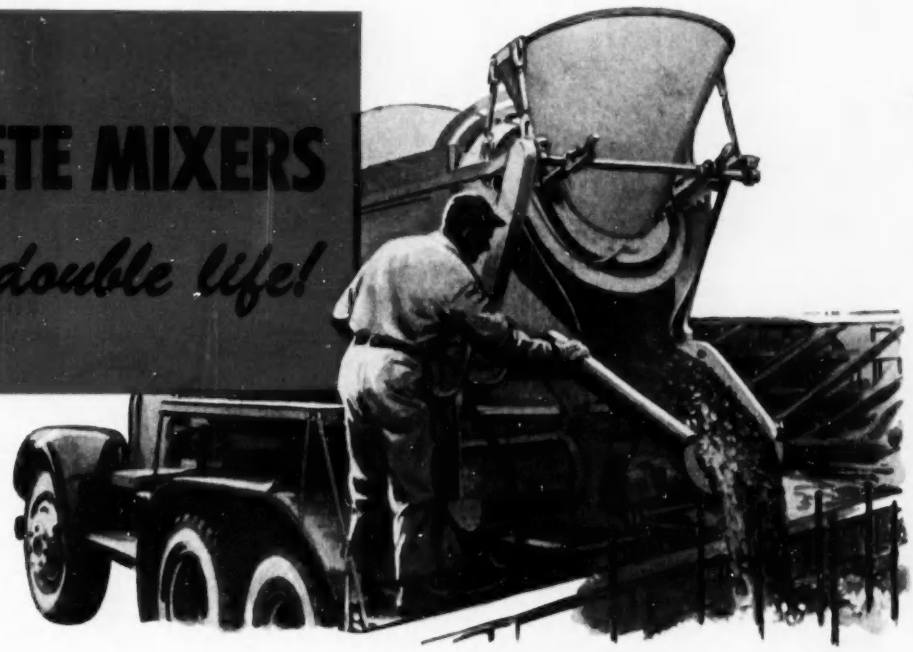
50 Years of Quality Manufacturing for the Automotive Industry

LONG

A PRODUCT OF BW BORG-WARNER

TORQUE CONVERTERS • CLUTCHES • RADIATORS • OIL COOLERS

CONCRETE MIXERS *lead a double life!*

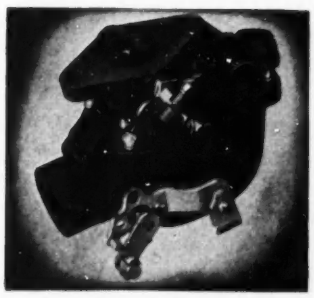


WHAT *we* learned about the double life of truck concrete mixers enables us to help engine manufacturers a lot when it comes to properly designing and calibrating carbureters.

One of our field service men brought us this story. After three or four days' normal operation, the exhaust of the concrete mixer engine gave off heavy black smoke. Changing the idle mixture ratio corrected the trouble temporarily. The cause was a double life!—long periods of low-speed, light-load operation, and very short periods of peak load. The result was rapid gumming and carbonization of the idle system.

The engine had the wrong carbureter—one designed for steady loads at high speed! To correct the trouble, we recommended a new idle system. Now, the engine manufacturer reports that test units operated six months during the peak season required no adjustment.

Over the years, Marvel-Schebler has accumulated a wealth of experience in carbureter applications for industrial engines. This experience is invaluable to Marvel-Schebler customers. If *your* engines are used in diversified markets requiring versatile carbureter performance, bring us your problems.

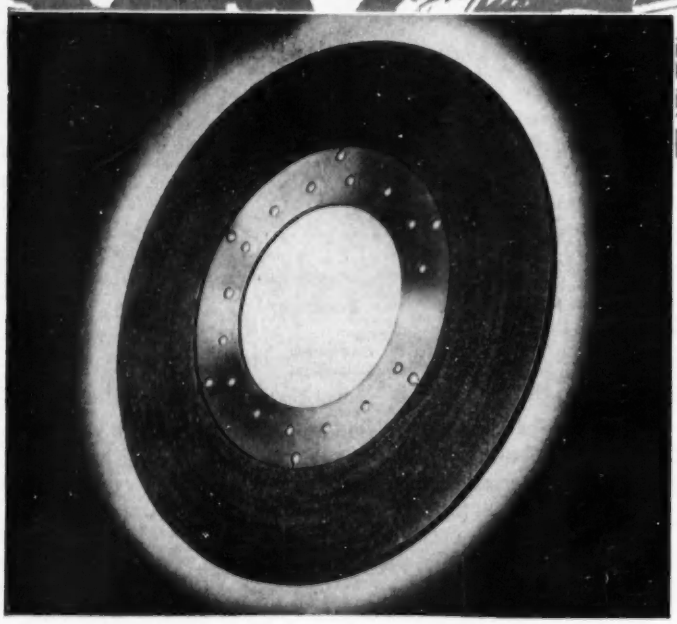


MARVEL-SCHEBLER PRODUCTS DIV.
Borg-Warner Corp., Decatur, Ill.

BW

MARVEL-SCHEBLER *Carbureters*

R/M
FIRST IN FRICTION



In this crawler tractor, shifting is virtually eliminated by the hydraulic torque converter drive . . . and in this drive, a clutch plate assembly by Raybestos-Manhattan provides a vital link. Two 17" diameter R/M Vee-Lok® woven asbestos clutch facings bonded to a steel core provide smooth power flow through the entire range of operation . . . and with great durability. These facings help the tractor operate dependably under the toughest operating conditions, with drawbar pulls up to 65,000 pounds.

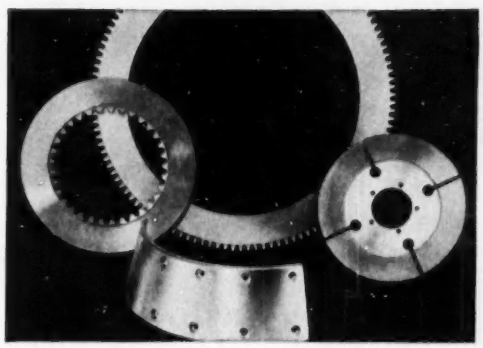
THE TRADE-MARK THAT SPELLS PROGRESS IN FRICTION MATERIAL DEVELOPMENT!

Advances in the field of friction materials for earth-moving equipment are but one phase of the continuing progress being made at Raybestos-Manhattan laboratories!

Similar advances in other fields are taking place all the time, through cooperation of design engineers and R/M research. This is true of the construction equipment industry, the mining machinery industry, the automotive industry, the office equipment industry, and many others.

To serve these many industries, R/M uses countless combinations of different types of friction material . . . including woven and molded asbestos, semimetallic materials, and sintered metal parts. Several of the newest developments in this important field stem from R/M's continuing research in powder metallurgy.

Whatever *your* friction material problem, your R/M representative is ready to help. He can work from samples, from designs on paper, from figures on horsepower developed combined with desired performance characteristics. Behind him stand all the facilities of the world's largest maker of friction materials . . . with six great plants, their research departments, and their testing laboratories.



Sintered metal parts are being used more and more in applications that require close tolerances, plus exceptional adaptability to working conditions such as operation in oil. Production capacity for R/M sintered metal parts is now greater than ever.

Write for Engineering Bulletin illustrating examples of R/M friction materials, for the aviation, agricultural and automotive industries . . . among others

RAYBESTOS-MANHATTAN, INC.

EQUIPMENT SALES DIVISION 6010 Northwest Highway, Chicago 31, Ill.
Detroit 2 Cleveland 14 Los Angeles 11

Factories: **Bridgeport, Conn. Manheim, Pa. Passaic, N.J. No. Charleston, S.C.**
Crawfordsville, Ind. Neenah, Wis. Canadian Raybestos Co. Ltd., Peterborough, Ont.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Brake Linings • Brake Blocks • Clutch Facings Fan Belts • Radiator Hose • Industrial Rubber Products • Rubber Covered Equipment • Packings • Teflon Products • Asbestos Textiles • Sintered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

RM
FIRST IN FRICTION

New AiResearch ram air turbine does a 250 pound job for jets... *weighs only 17 pounds!*

At last a *light weight* emergency power source to operate power controls in case of single engine failure! The new AiResearch ram air turbine develops a minimum of 3.4 hp at air speeds from 130 knots to above Mach 1 . . . *at any altitude.* It is now in production.

Features:

- Supplies enough power to operate a 3000 p.s.i. hydraulic system.
- Completely self-governed.
- Mounted internally and either extended into air stream or provided with ducted air flow.
- Occupies less than 3/4 of a cubic foot of space, eliminating previously required cumbersome storage batteries and electric motors.
- *Saves more than 200 pounds!*

This ram air turbine is another example of AiResearch design and production ingenuity in the field of high-altitude, high-speed flight.

Would you like to work with us? Qualified engineers, scientists and skilled craftsmen are needed here.

AiResearch Manufacturing Company

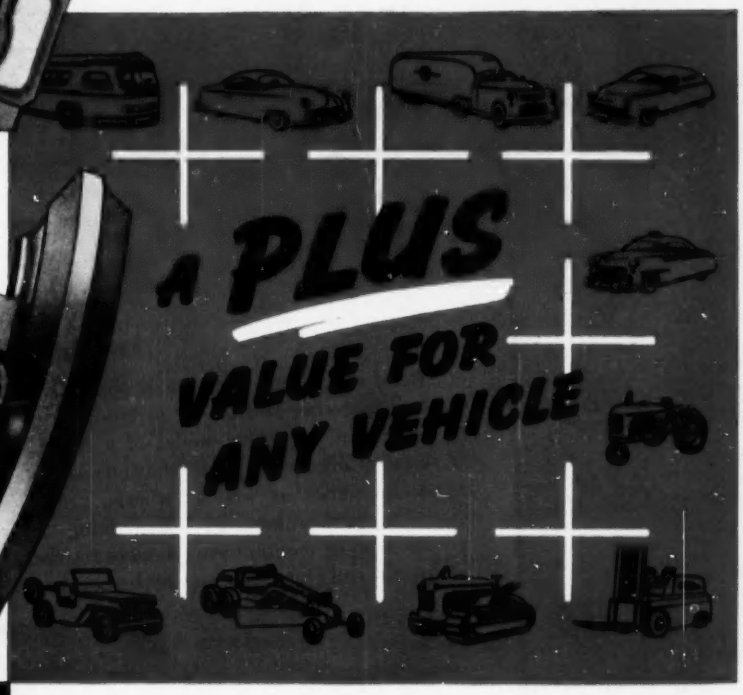
A DIVISION OF THE GARRETT CORPORATION

LOS ANGELES 45, CALIFORNIA • PHOENIX, ARIZONA

DESIGNER AND MANUFACTURER OF AIRCRAFT EQUIPMENT IN THESE MAJOR CATEGORIES

Air Turbine Refrigeration | Heat Transfer Equipment | Electric Actuators | Gas Turbines | Cabin Superchargers | Pneumatic Power Units | Electronic Controls | Cabin Pressure Controls | Temperature Controls

THE WORLD-FAMOUS AETNA T-TYPE CLUTCH RELEASE BEARING



Plus VALUE FEATURES

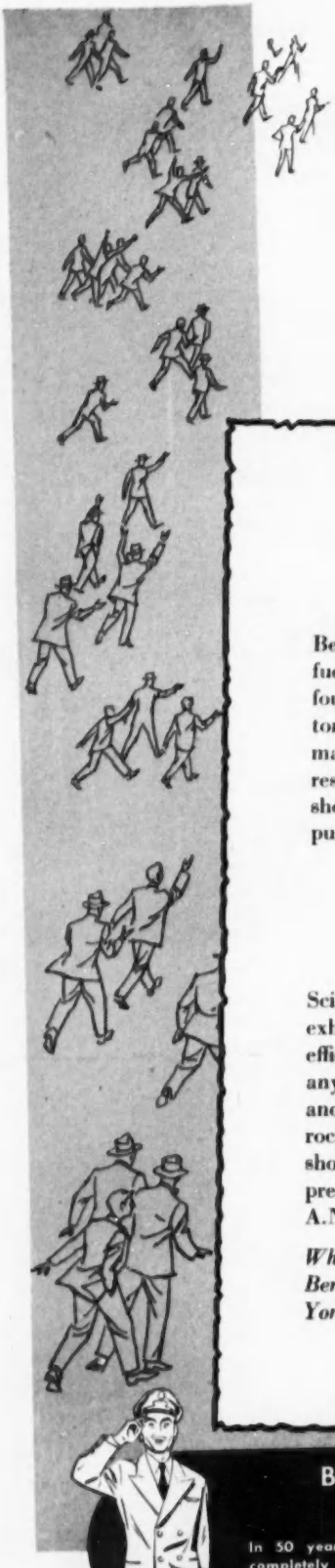
- T-shaped oil-impregnated bronze ball separator maintains perfect concentricity—eliminates eccentric thrust, excessive wear—assures the plus smoothness, quietness and endurance of bronze-to-steel contact.
- Large, factory-packed grease reservoir assures lifetime lubrication—no need for costly grease fittings or oil lines.
- Special construction locks shell to free race, forming leak-proof joint. Lubricant can't escape to clutch facings, never needs replenishment.
- Case hardened races for wear-resistant working surface and tough, elastic, shock-absorbing core.

Standard and Special Ball Thrust Bearings • Angular Contact Ball Bearings • Special Roller Bearings • Ball Retainers • Hardened and Ground Washers • Sleeves • Bushings • Miscellaneous Precision Parts.

In 1953, as in the past 19 years more of the nation's mobile vehicles will be equipped with the Aetna T-Type clutch release bearing than with any other type. Its unrivaled service life has always made it the most economical in the long run. Once installed it is trouble-free, attention-free for vehicle life. Thanks to its design and lubricant capacity there's no need of costly machining operations for oil lines or grease fittings—no need for further maintenance whatsoever. Think what that saves in man and machine hours on the assembly line, in saving up-keep costs for the vehicle owner.

It's a trusty sign of dependability and economical performance in any vehicle—the famous Aetna T-Type bearing. Investigate. Find out the many other sound reasons it deserves a place in your specifications.

AETNA BALL AND ROLLER BEARING COMPANY
4600 Schubert Avenue • Chicago 39, Illinois
In Detroit — Sam T. Keller, 2457 Woodward Avenue



look for the latest at the BENDIX EXHIBIT

S.A.E. Aeronautics Conference

STATLER HOTEL—PENN TOP ROOM

NEW YORK, N. Y.

April 20 to 24

Scintilla Magneto Division, Booth 9
Bendix Products Division, Booth 30-31

Bendix Products Division

SOUTH BEND, INDIANA

Bendix Products Division is recognized in the aviation industry as first in fuel metering and leader in landing gear. In this division's exhibit will be found an operating model of a full-size nose strut—the newly developed torque-link steering unit that effects important savings in weight, space and maintenance as well as wheels, brakes and the revolutionary new heat-resistant Cerametallic brake lining. Also on display will be a complete showing of fuel metering devices for reciprocating and jet engines, including pump and electronic and hydro-mechanical controls.

Bendix

SCINTILLA MAGNETO DIVISION, SIDNEY, N. Y.

Scintilla Magneto Division—the Most Trusted Name in Ignitions—will exhibit the Bendix Ignition Analyzer—the unit that not only checks the efficiency of spark plugs and ignition systems, but actually predicts in advance any possibility of ignition failures. The Scintilla exhibit also includes low and high tension ignition systems for reciprocating turbo-jet engines and rocket motors as well as the famous Bendix magneto. Another interesting showing consists of Bendix Scinflex Electrical Connectors—completely pressurized, available in all contact size and pin arrangements with full A.N. approval.

Whether your needs are for today's products or tomorrow's plans, a visit to the Bendix Exhibit at the S.A.E. Aeronautics Conference, Hotel Statler, New York City, should prove most profitable.

Bendix Salutes the Aviation Industry on its Golden Anniversary

In 50 years the aviation industry has completely changed all former concepts of time and distance and profoundly affected people's lives all over the world.

Bendix Aviation Corporation is proud that its products have helped to advance speed, range and safety, and pledges its resources to meet the challenge of the future.

THE NAME Bendix AVIATION CORPORATION MEANS TRUST

PERMITE VALVES

Chosen for their Proven Performance!

LEADING automotive engineers specify Permite Valves not once or twice, but year after year. They have found that Permite delivers the quality of metals, the rugged strength and maximum performance expected . . . every time.

For over thirty years Permite engineers have cooperated with automotive and industrial engine builders in developing valves, pistons and other parts to achieve new standards of engine performance. We invite consultation on your requirements.

ALUMINUM INDUSTRIES, INC. - CINCINNATI 25, OHIO

DETROIT: 809 New Center Building

NEW YORK: 9 Rockefeller Plaza

CHICAGO: 64 E. Jackson Boulevard

PERMITE

ALUMINUM PERMANENT MOLD and SAND CASTINGS . . . HARDENED, GROUND and FORGED STEEL PARTS

For ROUGH TOUGH HARD going

SENIOR CONTOUR NO. 1893

Cushion Seats

MILSCO BRINGS YOU NEWEST ADVANTAGES IN SEATING COMFORT AND DURABILITY

COMMANDER NO. 1144

With or Without Fore and Aft Attachment

Improved driver-comfort is one of today's major engineering objectives . . . and Milsco can help you to step up the man-work-factor of your equipment with job-fitted cushion seating. Milsco Cushion Seats are the developments of years of experience in designing and manufacturing heavy duty cushion seats for all types of mobile equipment. Our field studies of enduring cushioning materials and contour body support may prove of important value to you. Write us about your seating problem now.

Sold Only to Original Equipment Manufacturers

ESTABLISHED 1924

Milsco MILWAUKEE

MILSCO MANUFACTURING CO.
2758 N. 33rd ST., MILWAUKEE 45, WIS.

ENGINEERS:

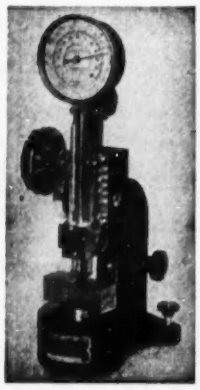
We've Got what you're Looking for!

T. H. Beck, Manager of Engineering. Is an engineering veteran of over 22 years in the aviation and related industries.

A secure future, exceptional opportunities for advancement, and a high starting salary await you at FAIRCHILD. We have openings right now for qualified engineers and designers in all phases of aircraft manufacturing; we need top-notch men to help us in our long-range military program: turning out the famous C-119 Flying Boxcar and other projects for the U.S. Air Force.

FAIRCHILD provides paid vacations and liberal health and life insurance coverage. We work a 5-day, 40-hour week as a base. Premium is paid when longer work week is scheduled.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD *Aircraft Division*
HAGERSTOWN, MARYLAND



HARDNESS TESTING

Brinell—Shore—Scale

Included in our improved Portable Sclero-scope Model D-1. This efficient single scale tester registers Brinell-Shore values without damage to the work. The old standby for thirty-five years.

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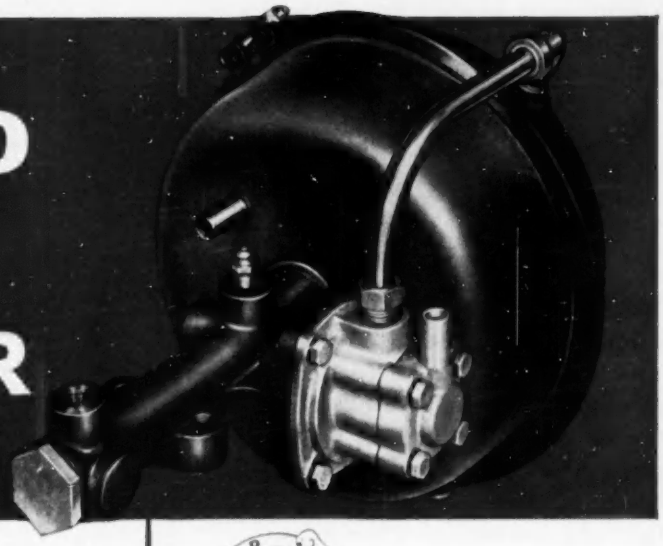

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Requires no lubrication — therefore performance characteristics do not change with extremely low or high temperatures.

Absolutely air tight at all times and in any position of its stroke.

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Operation not affected by moisture or condensation.

Performance not impaired by body dents or dings.

More economical to service.

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Now . . . the new, improved Midland Vacuum Hy-Power offers:

Improved performance
Greater capacity
Increased line pressure
Approximately same over-all size
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Lighter weight

EVERY DAY more and more trucks and trailers are being equipped with Midland Power Brakes.

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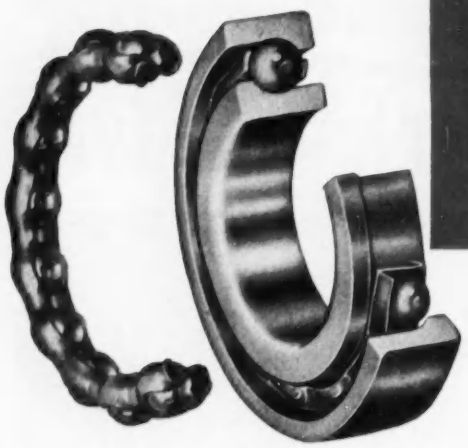

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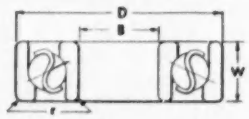

Single Row—Light

Bearing Numbers Contact Angle			Bore B		Outside Diameter D		Width W		Fillet Radius* r	Balls	
Medium	Low	High	Mm.	Inches	Mm.	Inches	Mm.	Inches	Inches	No.	Size
7204-A	7204-N	7204-T	20	0.7874	47	1.8504	14	0.5512	0.040	12	1/4
7205-A	7205-N	7205-T	25	0.9843	52	2.0472	15	0.5906	0.040	11	5/16
7206-A†	7206-N†	7206-T†	30	1.1811	62	2.4409	16	0.6299	0.040	11	11/32
7207-A	7207-N	7207-T	35	1.3780	72	2.8346	17	0.6693	0.040	12	11/32
7208-A	7208-N	7208-T	40	1.5748	80	3.1496	18	0.7087	0.040	13	7/16
7209-A	7209-N	7209-T	45	1.7717	85	3.3465	19	0.7480	0.040	14	7/16
7210-A	7210-N	7210-T	50	1.9685	90	3.5433	20	0.7874	0.040	15	7/16
7211-A	7211-N	7211-T	55	2.1654	100	3.9370	21	0.8268	0.060	12	1/2
7212-A	7212-N	7212-T	60	2.3622	110	4.3307	22	0.8661	0.060	15	17/32
7213-A	7213-N	7213-T	65	2.5591	120	4.7244	23	0.9055	0.060	14	15/16
7214-A	7214-N	7214-T	70	2.7559	125	4.9213	24	0.9449	0.060	16	15/16
7215-A	7215-N	7215-T	75	2.9528	130	5.1181	25	0.9843	0.060	17	15/16
7216-A	7216-N	7216-T	80	3.1496	140	5.5118	26	1.0236	0.080	16	1
7217-A†	7217-N†	7217-T†	85	3.3465	150	5.9055	28	1.1024	0.080	15	1 1/16
7218-A	7218-N	7218-T	90	3.5433	160	6.2992	30	1.1811	0.080	15	1 1/16
7219-A	7219-N	7219-T	95	3.7402	170	6.6929	32	1.2598	0.080	15	1 1/16
7220-A	7220-N	7220-T	100	3.9370	180	7.0866	34	1.3386	0.080	15	1
7221-A	7221-N	7221-T	105	4.1339	190	7.4803	36	1.4173	0.080	15	1 1/16
7222-A	7222-N	7222-T	110	4.3307	200	7.8740	38	1.4961	0.080	15	1 1/16
7224-A	7224-N	7224-T	120	4.7244	215	8.4646	40	1.5748	0.080	15	1 1/16
7226-A	7226-N	7226-T	130	5.1181	230	9.0551	40	1.5748	0.100	16	1 1/4
7228-A	7228-N	7228-T	140	5.5118	250	9.8425	42	1.6535	0.100	16	1 1/16

Single Row—Medium

Bearing Numbers Contact Angle			Bore B		Outside Diameter D		Width W		Fillet Radius* r	Balls	
Medium	Low	High	Mm.	Inches	Mm.	Inches	Mm.	Inches	Inches	No.	Size
7303-A	7303-N	7303-T	17	0.6693	47	1.8504	14	0.5512	0.040	12	1/4
7304-A	7304-N	7304-T	20	0.7874	52	2.0472	15	0.5906	0.040	10	5/16
7305-A†	7305-N†	7305-T†	25	0.9843	62	2.4409	17	0.6693	0.040	10	3/8
7306-A	7306-N	7306-T	30	1.1811	72	2.8346	19	0.7480	0.040	10	15/32
7307-A	7307-N	7307-T	35	1.3780	80	3.1496	21	0.8268	0.060	10	17/32
7308-A	7308-N	7308-T	40	1.5748	90	3.5433	23	0.9055	0.060	10	19/32
7309-A	7309-N	7309-T	45	1.7717	100	3.9370	25	0.9843	0.060	11	15/16
7310-A	7310-N	7310-T	50	1.9685	110	4.3307	27	1.0630	0.080	12	21/32
7311-A†	7311-N†	7311-T†	55	2.1654	120	4.7244	29	1.1417	0.080	12	23/32
7312-A†	7312-N†	7312-T†	60	2.3622	130	5.1181	31	1.2205	0.080	12	7/8
7313-A†	7313-N†	7313-T†	65	2.5591	140	5.5118	33	1.2992	0.080	12	15/16
7314-A	7314-N	7314-T	70	2.7559	150	5.9055	35	1.3780	0.080	12	1
7315-A†	7315-N†	7315-T†	75	2.9508	160	6.2992	37	1.4567	0.080	12	1 1/16
7316-A†	7316-N†	7316-T†	80	3.1496	170	6.6929	39	1.5354	0.080	12	1 1/16
7317-A†	7317-N†	7317-T†	85	3.3465	180	7.0866	41	1.6142	0.100	12	1 3/16
7318-A†	7318-N†	7318-T†	90	3.5433	190	7.4803	43	1.6929	0.100	12	1 1/4
7319-A†	7319-N†	7319-T†	95	3.7402	200	7.8740	45	1.7717	0.100	12	1 5/16
7320-A†	7320-N†	7320-T†	100	3.9370	215	8.4646	47	1.8504	0.100	12	1 7/16
7321-A†	7321-N†	7321-T†	105	4.1339	225	8.8583	49	1.9291	0.100	12	1 1/2
7322-A†	7322-N†	7322-T†	110	4.3307	240	9.4488	50	1.9685	0.100	12	1 5/8

* Bearing corner radii will clear maximum fillet radius shown.
† For use of these sizes consult BCA Engineering Department.

BCA *radial, thrust, angular-contact Ball Bearings*

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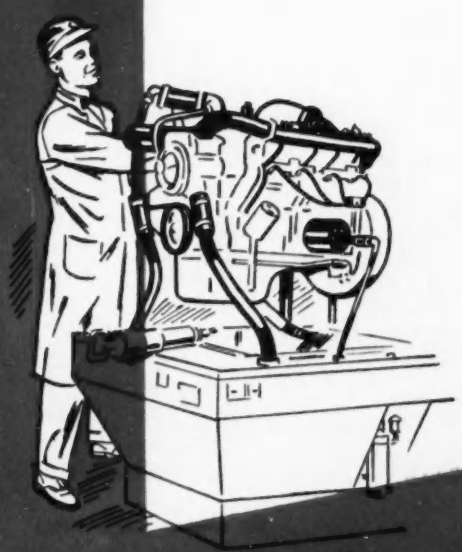
LOOK AT THESE TEST RESULTS . . .



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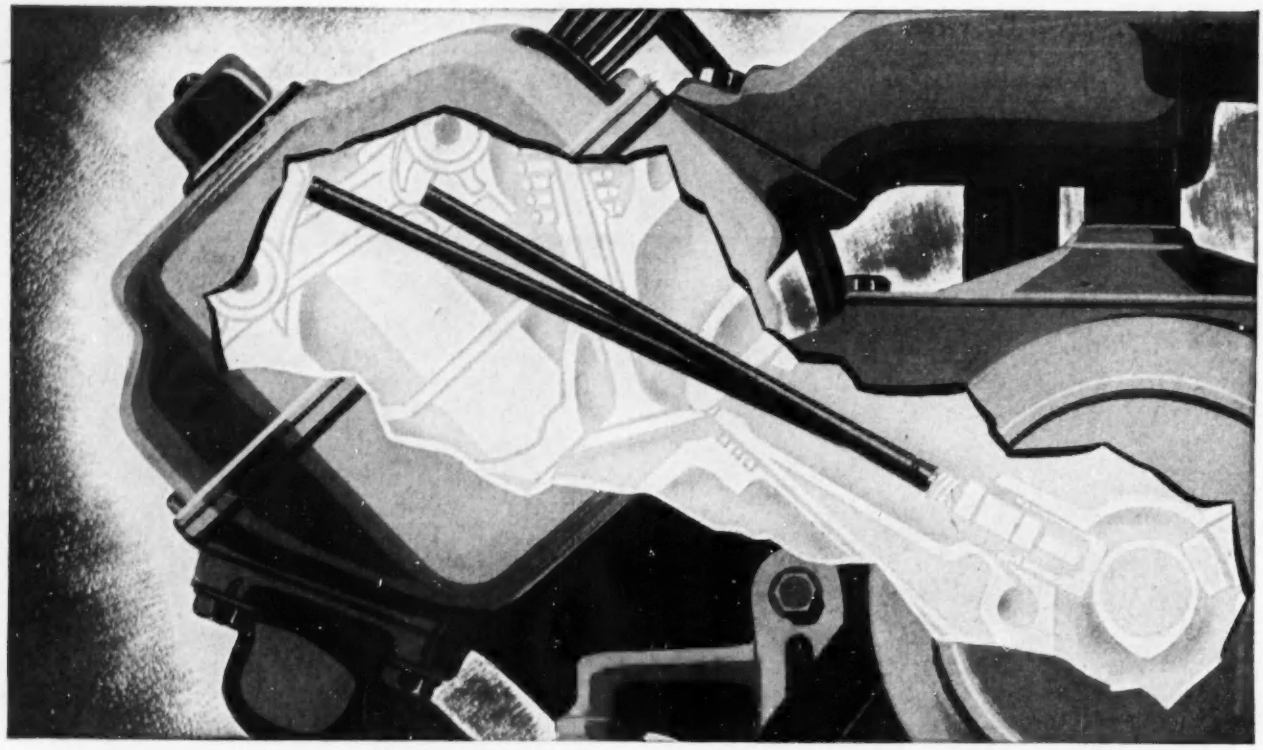
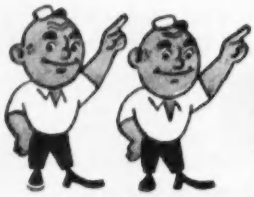


1 Today's sharp swing toward higher horsepower overhead engines for passenger cars has resulted in many new solutions to old automotive problems. One result: Push rods of Bundyweld Tubing, long proved in truck engines.



Push rods of Bundyweld Tubing called for by newest trend in engine design

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

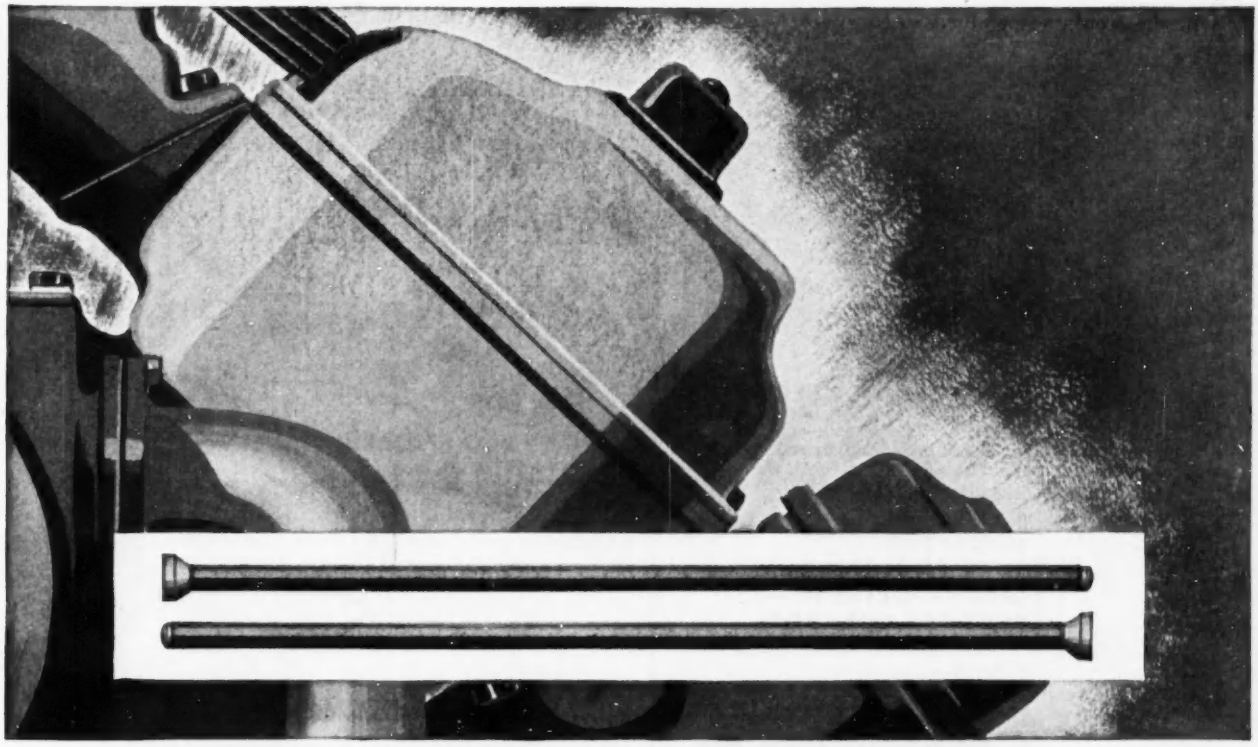
continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: *Cambridge 42, Mass.:* Austin-Hastings Co., Inc., 226 Binney St. ■ ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. ■ ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 47th Place ■ ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 ■ ***Philadelphia 3, Penn.:*** Ruton & Co., 1717 Sansom St. ■ ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. ■ ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., East ■ **Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.**



2 Tough, lightweight push rods of hardened Bundyweld reduce cam load, increase efficient function of entire valve train. Bundyweld fabricates more easily than the material it replaces, results in more uniform, better finished parts.

Push rods of Bundyweld, long used in powerful truck engines, help improve performance of powerful overhead-type passenger-car engines.

The improved push rods in the overhead engines of some of today's most popular cars are made of lightweight Bundyweld Tubing.

Lightweight push rods of Bundyweld reduce load on cam, and, of course, the entire valve train follows the cam more closely. The design engineer is thus able to produce a more efficient, more powerful overhead engine in keeping with today's constantly growing trend.

The tubing: Bundyweld is the only tubing double-walled from a single metal strip, with patented beveled edges. It's SAE 1010 steel, copper-bonded throughout 360° of wall contact into a strong, lightweight beadless tubing. Wall thickness and concentricity are uniform, accurate. Ultimate tensile strength, yield strength, and fatigue limit are exceptionally high.

Engineering help: If you'd like help in determining how to apply Bundyweld toward solving your push rod problems, why not talk things over with one of our experienced automotive tubing engineers? You'll find them a prime source of sound information and ideas—not only on push rods but on other tubing applications.

Production: We're already mass-producing Bundyweld for automotive push rods. And, naturally, we're ready to give you the same high-volume, low-cost service we're giving others. We'll ship Bundyweld—cold drawn to proper hardness, held to specified low camber tolerances—right on schedule.

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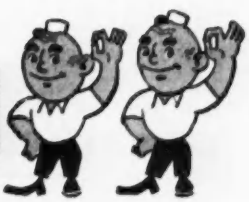
Bundyweld® Tubing



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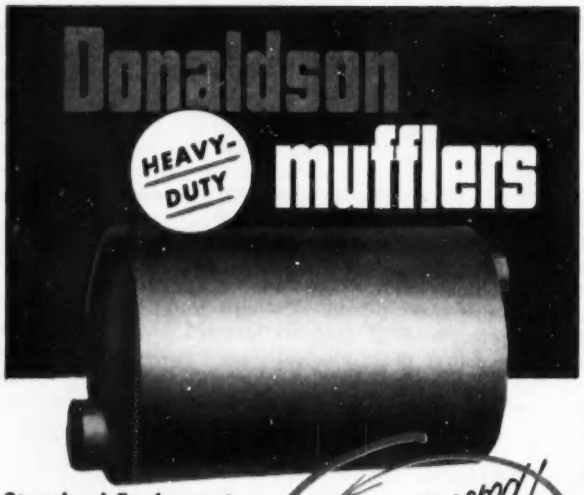

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PLUS PRODUCTION . . .

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—bores that are round and straight
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Microhoning equipment is available to handle all kinds and sizes of parts . . . from soft non-ferrous metals to hardened steel and special alloys . . . from .078 to 60 inches in diameter and from ¼ inches to 75 feet in length.

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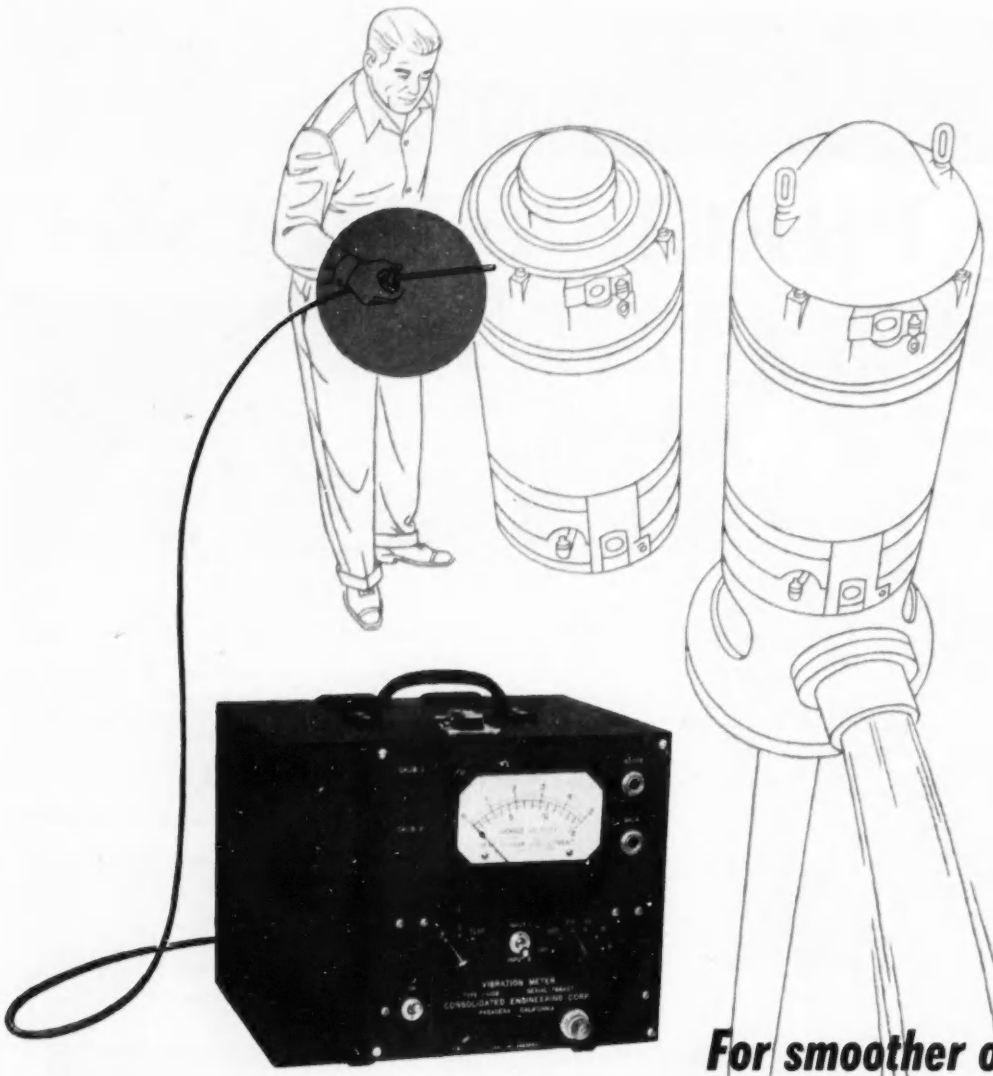

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The Pesco hydraulic pump is a gear design—the simplest of all hydraulic pumps. There are actually only three moving parts in the pump proper. Fewer moving parts mean—

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. . . less maintenance
. . . less cost for overhaul
. . . less weight
. . . less noise

plus the EFFICIENCY of "Pressure Loading" which makes possible:

"*Pressure Loading*" is Pesco's exclusive development that *automatically* holds end clearance of gears to a thin film of oil, thereby maintaining the volumetric efficiency throughout the long service life of the pump.

. . . volumetric efficiencies up to 97% over a wide range of temperatures

plus STATISTICAL QUALITY CONTROL which assures:

. . . uniform high quality and performance of each pump
. . . a longer, trouble-free service life

Simplicity of design, *efficiency* of "*Pressure Loading*" and *statistical quality control* in all phases of manufacture, are three important reasons why Pesco pumps are standard equipment on military and commercial aircraft and on many automotive and industrial products. Write today regarding your hydraulic pump requirements.

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PRODUCTS DIVISION

BORG-WARNER CORPORATION
24700 NORTH MILES ROAD • BEDFORD, OHIO

+ INDEX TO ADVERTISERS +

A

A. C. Spark Plug Div. General Motors Corp. 211
Aeroquip Corporation 183
Aetna Ball & Roller Bearing Co. 217
Aircraft Marine Products, Inc. 193
Airesearch Division of The Garrett Corp. 216
Allied Products Corp. 123
Aluminum Company of America 158
Aluminum Industries, Inc. 219
American Brakeblok Div. of the American Brake Shoe Co. 10
American Chemical Paint Co. 143
American Felt Co. 234

B

Barnes & Reinecke, Inc. 134
Bearings Company of America 222
Bendix Aviation Corp. Bendix Products Div. 16
Eclipse Machine Div. 127
Shows & Exhibits 218
Stromberg-Elmira Div. 225
Zenith Carburetor Div. 190
Bendix Westinghouse Automotive Air Brake Co. 159
Bethlehem Steel Co. 203
Borg & Beck Div., Borg-Warner Corp. 118
Borg-Warner Corp. 207
Bound Brook Oil-Less Bearing Co. 141
Bower Roller Bearing Co. 151
Bundy Tubing Co. 226, 227

C

Campbell, Wyant & Cannon Foundry Co. 187
C. A. V., Ltd. 116
Clark Equipment Co. 129, 130
Columbia-Geneva Steel Div. 204, 205
Consolidated Engineering Corp. 230
Cummins Engine Co., Inc. 137

D

Delco Products Div. General Motors Corp. 152
Dole Valve Company 113
Donaldson Co., Inc. 228
Douglas Aircraft Company, Inc. 170
Dow Corning Corp. 4

E

Eagle Pencil Company 167
Eaton Mfg. Co., Foundry Div. 164
Eaton Mfg. Co., Pump Div. 121
Eaton Mfg. Co., Saginaw Div. 163
Echlin Manufacturing Co. 185
Electric Auto-Lite Co. 188
Emery Co., A. H. The 147

F

Fafnir Bearing Co., The Inside Back Cover
Fairchild Engine & Airplane Corp. 220
Federal-Mogul Corp. 153
Firestone Steel Products Co. 173
Fuller Mfg. Co. 180

G

General Electric Co. 161
General Plate Div. Metals & Controls Corp. 12
Glass Fibers, Inc. 139
Globe-Union, Inc. 195
Graton & Knight Company 178
Great Lakes Steel Corp. 2
Gunite Foundries Corp. 197

H

Harvey Machine Co. 220
Herbrand Div. The Bingham-Herbrand Corp. 224
Hi-Shear Rivet Tool Co., The 150
Hughes Aircraft Company 150
Hyatt Bearings Div. General Motors Corp. 115

I

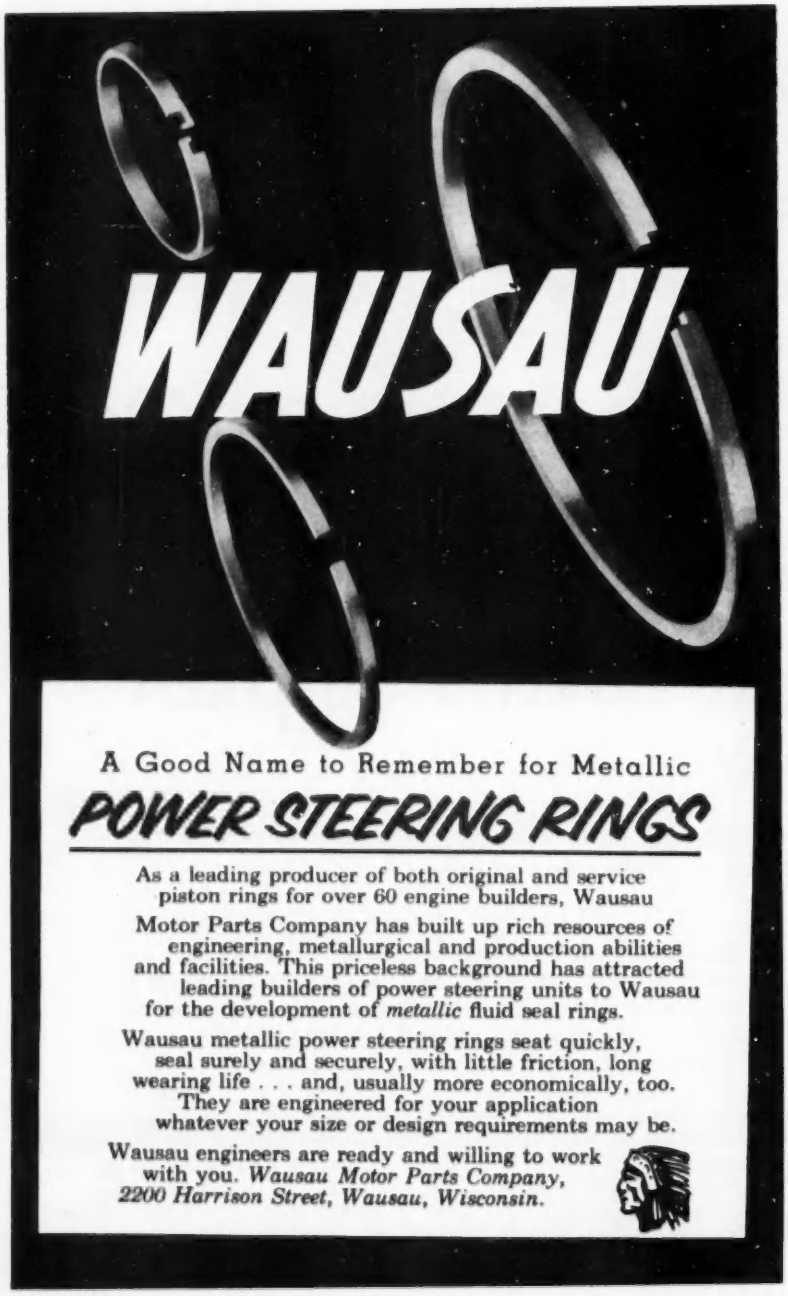
Imperial Brass Mfg. Co. 196
Imperial Pencil Tracing Cloth 224
Indiana Gear Works 145
International Nickel Co. 168
International Packings Corporation 178

K

Keuffel & Esser Co. 154, 155

L

Lear Inc., Grand Rapids Div. (Electro-Mechanical Equipment) 135
Libbey-Owens-Ford Glass Company 206
Link-Belt Co. 117
Lipe Rollway Corp. 192
Lisle Corp. 128
Lockheed Aircraft Corp. 179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+ INDEX TO ADVERTISERS +

Long Mfg. Div. Borg-Warner Corp. 212
Lord Manufacturing Co. 148
Lycoming Spencer Division AVCO Mfg. Co. 6

M

McQuay-Norris Manufacturing Company 160
Marvel-Schebler Products Div. Borg-Warner Corp. 213
Mechanics Universal Joint Div. Borg-Warner Corp. 165
Micromatic Hone Corporation 229
Midland Steel Products Co. 126, 221
Milsco Mfg. Co. 220
Minneapolis Honeywell 131
Minnesota Mining & Mfg. Co. 186
Moraine Products Div. General Motors Corp. 144
Morse Chain Co. 125

N

National Malleable & Steel Castings Co. 140
National Motor Bearing Co. 202
New Departure Div. General Motors Corp. 1
New York Air Brake Co. 191
North American Aviation, Inc. 131

O

O & S Bearing Company 136

P

Palnut Company 124
Parker Appliance Co. 133
Parker Rust Proof Co. 14
Perfect Circle Companies Inside Front Cover
Pesco Products Div. Borg-Warner Corp. 231
Pierce Governor Co., Inc. 169
Precision Rubber Products Corp. 3

R

Raybestos-Manhattan, Inc. Equipment Sales Div. 214, 215
Revere Copper & Brass, Inc. 11
Reynolds Metals Company 8, 9
Rockford Clutch Div. Borg-Warner Corp. 114
Rohr Aircraft Corp. 182
Rollway Bearing Company 174
Ross Gear & Tool Co. 5
Ryan Aeronautical Company 162

S

Saginaw Steering Gear Div. General Motors Corp. 208
Sealed Power Corp. 177
Shore Instrument & Mfg. Co., Inc. 220
SKF Industries, Inc. 166
Spencer Thermostat Div. Metals & Controls Corp. 142
Spicer Mfg. Div. of the Dana Corp. 199, 200
Standard Electric Time Company 194
Standard Steel Spring Co. 149
Sterling Aluminum Products, Inc. 223
Stewart-Warner Corp. 7
Sturtevant Company, P. A. 224, 228
Superior Steel Corp. 181

T

Tennessee Coal & Iron Div. 204, 205
Thompson Products, Inc., Detroit Div. 189
Thompson Products, Inc., Light Metals Div. 119
Thompson Products, Inc., Special Products Div. 157
Timken-Detroit Axle Co. 209, 210
Timken Roller Bearing Co., Steel & Tube Div. Outside Back Cover
Torrington Co. (Needle Bearings) 156
Tung-Sol Electric, Inc. 122
Twin Disc Clutch Co. 132

U

United-Carr Fastener Corp. 201
United States Rubber Co., Engineered Rubber Products Div. 176
United States Steel Company 204, 205
United States Steel Supply Div. Warehouse Distributors 204, 205
Universal Products Co., Inc. 171

V

Vickers, Inc. 184
Victor Manufacturing & Gasket Co. 175

W

Wagner Electric Corp. 172
Waldes Kohinoor, Inc. 198
Wallace & Tiernan Products, Inc. 224
Waterman Products Co., Inc. 138
Wausau Motor Parts Company 232, 233
Wellman Company, S. K., The 146

Y

Yates-American Machine Co. 120

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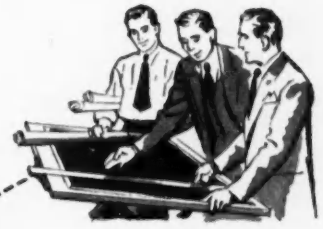
DESIGN STRATEGY that gets the most from motion



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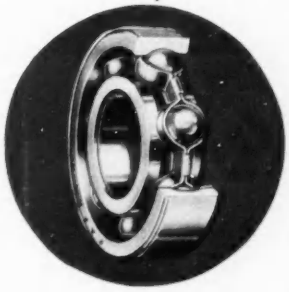

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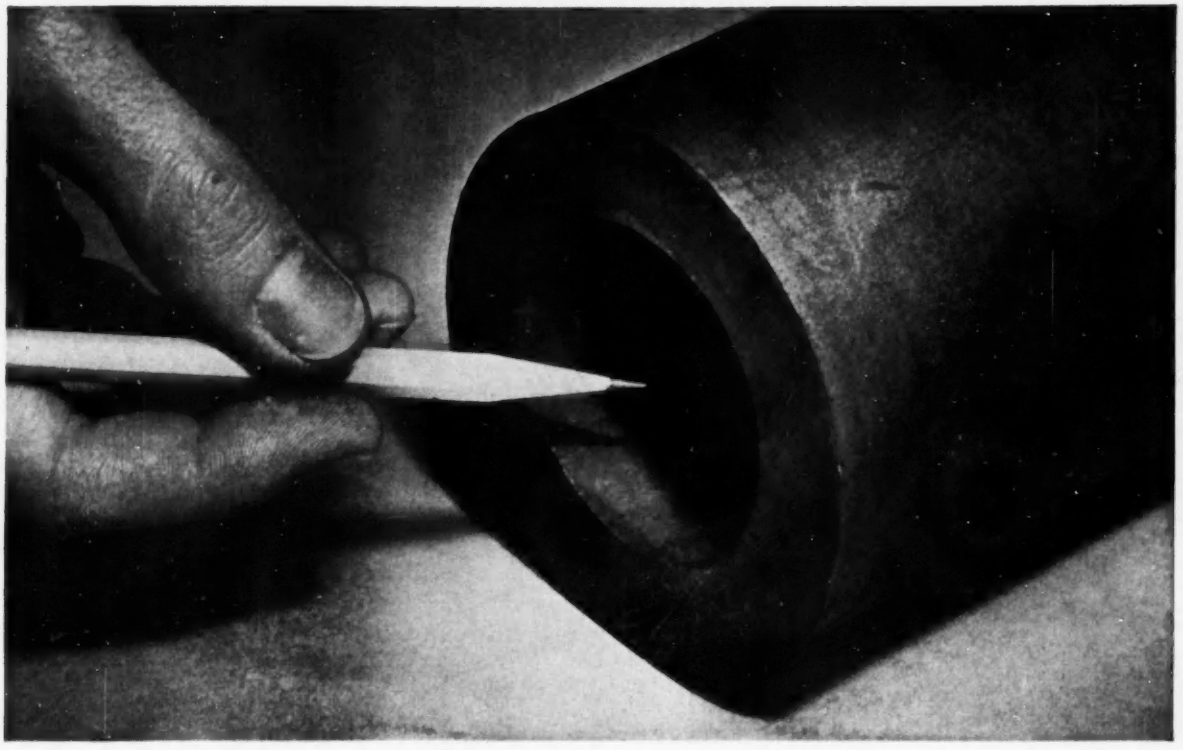

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